

JPRS-UST-94-006

9 March 1994



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# ***JPRS Report***

# **Science & Technology**

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***Central Eurasia***

# Science & Technology

## Central Eurasia

JPRS-UST-94-006

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9 March 1994

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## CHEMISTRY

### **Luminescent Determination of Polyaromatic Hydrocarbons Against Background of Characteristic Luminescence in Natural, Potable, and Waste Waters**

947M0012B Moscow *ZHURNAL ANALITICHESKOY KHIMII* in Russian Vol 48, No 12, Dec 93  
pp 1983-1990

[Article by G. I. Romanovskaya and N. A. Lebedeva, Geochemistry and Analytical Chemistry Institute imeni V. I. Vernadskiy, Moscow; UDC543.70]

[Abstract] The control of trace quantities of organic substances of industrial origin, such as petroleum and petroleum products, in natural, potable, and waste waters is becoming more and more significant from the environmental standpoint. Luminescent methods are normally used to detect contamination from petroleum products. The visible fluorescence of petroleum and petroleum products results from the presence of aromatic and heterocyclic compounds absorbed in the ultraviolet region of the spectrum. However, it bears noting that modern spectrofluorometric methods for detecting traces of petroleum products in water are encumbered with lengthy sample preparation (extraction, sorption) in order to separate the polycyclic aromatic hydrocarbons (PAU). In natural waters, PAU fluorescence is recorded against a background of dissolved organic substances (ROV) and a spontaneous Raman spectrum of excited illumination on the water molecules, thus making it impossible to determine trace quantities of PAU directly without their preliminary separation. Synchronous spectrofluorometric methods are an exception, although they require costly equipment and specially trained personnel. Thus the problem of an express method for detecting and assaying the degree of contamination remains in essence the as the isolation of a fluorescence signal of PAU against a background of ROV illumination. In the present work an express laser-luminescent technique was developed which makes it possible to conduct spectral fractionation of PAU contamination without supplemental treatment of the water sample. The use of periodic pulsed excitation in conjunction with signal gathering enables determination of PAU within the range  $5 \times 10^{-10}$  -  $1 \times 10^{-7}$  g/ml. Figures 5; references 8: 3 Russian, 5 Western.

### **Ion-Selective Electrodes Based on Neutral Carriers as Sensors of Organic Cations. Membraned Octylammonium-Selective Electrodes Based on Phosphoryl-Containing Podands**

947M0012A Moscow *ZHURNAL ANALITICHESKOY KHIMII* in Russian Vol 48, No 12, Dec 93  
pp 1974-1982

[Article by N. B. Shvedene, I. V. Pletnev, M. Yu. Nemilova, O. D. Sinenko, N. M. Sheina, and V. Ye.

Baulin, Moscow State University imeni M. V. Lomonosov; UDC543.257.1]

[Abstract] Plasticized electrodes having a membrane containing a neutral carrier (crown-ester, as a rule) are being used more frequently for the potentiometric determination of amines. These electrodes are selective and have useful operational features. The mechanism of their functioning includes a "guest-host" complex formation stage, where the protonated amine cation becomes bound to the carrier molecule with hydrogen bonds and ion-dipole interaction. It may be supposed that macrocyclic polyesters are interchangeable with ionophores having an open chain, particularly podands—compounds in which the polyester chain has basic terminal groups (phosphine oxides, for example) attached to it. These reagents, similar to crown-esters, are capable of interacting with metals, and possibly also with amines. The procedures for synthesizing podands are more accessible than those of cyclic polyesters, thereby facilitating structural variations in the search for the most effective ionophore. The relative conformational lability of non-cyclic molecules ensures satisfactory kinetic characteristics of electrodes made from them. In the present work podands having diphenylphosphine oxide terminal groups and a lengthy polyester chain were synthesized and tested as electrode-active materials. For comparison, a study was also made of the properties of triphenylphosphine oxide, an analog of an "isolated terminal group", and the classic crown-ester dibenzo-18-crown-6. An ion selective electrode having a plasticized membrane based on an acyclic polyester having diphenylphosphine oxide terminal groups was developed and used to determine octylammonium ions in aqueous solutions. The basic electrode characteristics were found to be a function of the nature of the electrode active component of the membrane. Ion-selective electrodes based on podands having three polyester oxygen atoms had optimum properties. An electrode having an o-nitrophenyloctyl ester as plasticizer manifested the longest service life (about 3 months). A method was also developed for the ionometric determination of octylammonium ions in model solutions under stationary conditions and in a counter-current mode. Figures 3; references 13: 5 Russian, 8 Western.

## CHEMICAL INDUSTRY

### **Synthesis of m-Carboranedicarbonic Acid Salts and Their Use To Obtain Metal-Containing Polymers**

947M0006B Moscow *DOKLADY AKADEMII NAUK* in Russian Vol 332 No 5, Oct 93 pp 601-602

[Article by V.A. Sergeyev, N.I. Bekasova, M.A. Surikova, Ye.A. Baryshnikova, Ya.V. Genin, and N.K. Vinogradova, imeni A.V. Nesmeyanov, Elementoorganic Compounds Institute imeni A.N. Nesmeyanov, Russian Academy of Sciences, Moscow; UDC 678.7:661.7:661.8]



[Abstract] A group of researchers synthesized salts of m-carboranedicarbonic acid and used them to produce a series of metal-containing polymers. The researchers synthesized oligomer salts of m-carboranedicarbonic acid and the following bivalent metals: Mg, Ca, Mn, Cu, Zn, Cd, Ba, and Pb. According to x-ray analysis, all of the m-carboranedicarbonic acid salts except for the Ba salts were crystalline substances. Most dissolved readily in water, as well as in alcohol and acetone in the presence of water. The infrared [IR] spectra of all of the salts produced were analogous to one another and contained absorption bands characteristic for a BH-carborane grouping (2,620/cm) and COO<sup>-</sup>-salt (1,590-1,650 and 1,270-1,300/cm) bond. According to the elemental analysis performed, every link of the salt, except in the case of the Pb salt, contained one or two molecules of crystallization water that can be removed by vacuum heating at temperatures above 100°C. The water may also be easily replaced by materials such as acetone, diethyl ether, and diethylamine. The Ba salt proved to be unstable in an aqueous solution because of its reaction with the CO<sub>2</sub> in air. The IR spectra of the Ca salt after treatment with diethylamine also contained absorption bands in the 2,959-2,980/cm range (characteristic of CH<sub>2</sub> and CH<sub>3</sub> groups). When heated in a vacuum to 220°C, all of the salts studied decomposed and released varying amounts of hydrogen depending on the individual metal involved. Upon thermal decomposition, the Cu salt released the most hydrogen, and the Mn and Mg salts released the least. X-ray phase analysis established that heating the Cu, Zn, Pb, and Cd salts to 220-380°C for 2-4 hours resulted in the formation of pure metals. Pure metals were also formed when the Cu, Pb, and Cd salts were added to polyiminoimides or phenol-formaldehyde resins in the amount of 30 weight percent. The size of the metal particles thus produced ranged from 50 to 300 angstroms depending on treatment temperature. The researchers expressed the hope that the m-carboranedicarbonic acid salts studied can eventually be used to dope various polymers with unoxidized metals in a finely dispersed state so as to produce metal-containing polymers with interesting electrical, magnetic, and other properties. Figure 1, tables 2; references 6: 2 Russian, 4 Western.

**Registering Electromagnetic and Corpuscular Radiations by Using Light-Sensitive Materials Containing Silver Halide and Sodium Tungstate**

947M0006A Moscow DOKLADY AKADEMII NAUK in Russian Vol 332 No 5, Oct 93 pp 585-586

[Article by B.U. Barshchevskiy and R.V. Ryabova, Kurchatov Institute Russian Scientific Center, Moscow; UDC 541.141.771.53]

[Abstract] A study examined the effect of sodium tungstate on the photographic properties of high-resolution photographic materials for holography and selected nuclear photographic materials. The possibilities of partially replacing the silver halide in these emulsions by sodium tungstate was also studied. It was discovered that

when 80 percent of the silver halide in the photographic material was replaced by sodium tungstate (i.e., when the material's silver halide content was reduced from 9 to 1.5 g/m<sup>2</sup>), its photographic properties (specifically, its light sensitivity) actually improved. Similarly, type MR nuclear photographic material also became more sensitive after 60 percent of its silver halide was replaced by sodium tungstate and was not otherwise adversely affected by the substitution. The sodium tungstate-containing photographic materials remained stable after thermostatted aging at 50°C and 65 percent humidity for 3 days. The sodium tungstate-containing silver halide photographic materials also manifested a significant increase in optical density when their temperature was increased at the moment of exposure. This increase in optical density was observed throughout the entire light wave interval from 225 to 525 nm. When a light-sensitive layer containing sodium tungstate was heated to 115°C, its optical density increased in comparison with that recorded at 20°C. For radiation at wavelengths of 325, 350, 375, 400, and 475 nm, the ratio of the two optical densities measured at 115 and 20°C (i.e.,  $D_{115}/D_{20}$ ) amounted to 50, 11, 15.5, 15, and 20, respectively. The amount of fog in the photographic materials with and without sodium tungstate was about the same. After protracted storage of 6-12 months or more, however, more fog developed on the sodium tungstate-containing photographic materials than on the films without sodium tungstate. It was concluded that sodium tungstate acts as a catalyst of the silver compounds' decomposition process. When an antifogging agent was used or when the films were stored at reduced temperatures, however, the amount of fog in the sodium tungstate-containing photographic materials remained about equal to that in the films with no sodium tungstate. Tables 2; references 5 (Russian).

**Recovering Nitrogen Oxides by Catalytic Reduction With Natural Gas**

947M0005B Moscow KHIMIYA I TEKHOLOGIYA TOPLIV I MASEL in Russian No 10, Oct 93 pp 28-29

[Article by A.F. Lunin, A.Yu. Adzhiyev, T.N. Burdeynaya, R.I. Fedorova, and A.Yu. Platinin, GANG [not further identified] imeni I.M. Gubkin and Gas Processing Scientific Research Institute; UDC 66.097.3]

[Abstract] Catalytic reduction of nitrogen oxides to elemental nitrogen by various gases used as reducing agents is a much more promising way of recovering nitrogen oxides than conventional absorption and adsorption methods. Noble metals (i.e., platinum, palladium, ruthenium, rhodium, etc.) may serve as catalysts in selective reduction processes; however, their high cost and scarcity have spawned the search for cheaper alternatives. Noble metal oxides on different carriers and variable-valence metal oxides may be used as catalysts in nonselective reduction processes. In view of these facts, a



study was undertaken to find effective non-noble metal-containing catalysts that could be used to reduce nitrogen oxides with natural gas. The experiments were performed in a continuous reactor unit with a stationary catalyst layer at temperatures of 250-590°C with a space velocity of 3,000/h and  $\text{CH}_4:\text{NO}_x$  ratio of 10:1. The content of nitrogen oxides in the gas mixture at the reactor entrance and exit was determined by the calorimetric method and by gas-liquid chromatography. Eight catalysts were tested: STK, GIAP-8, NTK-10-1, NTK-10, nickel-chromium, palladized carbon, GIAP-16, and carbon-modified STK. With the exception of GIAP-8, all of the catalysts tested manifested a high catalytic activity during the nitrogen oxide recovery process. The main products of the reduction reaction were nitrogen, water, and carbon dioxide. A side reaction of methane and oxygen also occurred. The study established that most metal oxide-based commercial catalysts (i.e., with the exception of GIAP-8) may be used to virtually totally remove nitrogen oxides from gas mixtures at 290-590°C provided that the said gas mixture does not contain more than 3 weight percent oxygen. When greater amounts of oxygen are present, it is necessary to first remove the oxygen from the gas mixture by, for example, using a two-stage reactor. Tables 3; references 4 (Russian).

#### Oils of New Deposits in Dagestan

947M0005A Moscow *KHIMIYA I TEKHNLOGIYA TOPLIV I MASEL* in Russian No 10, Oct 93 pp 17-23

[Article by V.A. Dorogochinskaya, L.R. Kochuleva, E.D. Shulzhenko, and A.K. Gumarova, Grozno Petroleum Scientific Research Institute; UDC 661.61(470.67)]

[Abstract] The following new oils have been discovered in the territory of the Nogayskiy rayon in Dagestan: Kulinskaya, Nakazukhsкая, and Rifovaya. From a tectonic standpoint, the new deposits are all part of the Kum upheaval zone. Commercial oil deposits have been discovered in the sediments of the Lower Triassic Kum suite. The newly discovered oils were characterized as light, high-viscosity, high-congealing, low-sulfur, high-paraffin oils. The Nazakukhsкая oil was determined to be resinous and to have a higher coking capacity than the Kulinskaya or Rifovaya oils. Its yield of gasoline fractions up to 200°C is low (12.7 to 16.9 weight percent), and its yield of light fractions at temperatures up to 350°C ranges from 37.3 to 44.8 weight percent. The new oils' 120-230°C fractions fail to meet the requirements stipulated in State Standard [GOST] 10227-86 for jet fuels for a number of reasons, including density at 20°C, viscosity at 20°C (with the exception of the Kulinskaya oil), temperature of onset of crystallization, flash point, and acidity. Their sulfur and aromatic contents are quite acceptable from a jet fuel standpoint, however. The heavy kerosene fractions (150-280°C) of the Nazakukhsкая and Kulinskaya oils meet the requirements set in branch standard OST 3801407-80 for type KO-20 burning kerosene; the Rifovaya oil is too acidic but may be used after being made more alkaline. The diesel

fractions (140-320°C) of the Nazakukhsкая and Kulinskaya oils meet the requirements set in GOST 305-82 for L-0.2-40 summer diesel fuel in all respects except for viscosity at 20°C. Rifovaya oil meets the said requirements in all ways except for viscosity at 20°C and flash point. The 180-350 and 200-320°C fractions of Nazakukhsкая oil are a good raw material for producing L-0.2-40 low-sulfur, low-congealing diesel fuel. All of the diesel fractions have a high cetane rating (58-69) thanks to their elevated n-alkane content, and the 200-320°C fraction appears to be a good raw material for producing liquid paraffins thanks to its high n-alkane content (27-47 weight percent). As a raw material for catalytic cracking, the 350-450°C fractions are characterized by a low sulfur content (0.05-0.11 weight percent) and low coking capacity (0.15-0.38 weight percent) and by a virtual absence of metals. The new oils have also been deemed valuable raw materials for obtaining base-stock oils and solid paraffins with high indicators. In accordance with branch standard OST 38.011.97-80, the three new oils have all been given the identical index 1.3.3.1.3. Figure 1, tables 4.

#### Superconducting Ceramic $\text{YBa}_2\text{Cu}_3\text{O}_7$ , Obtained by Sintering Eutectic $\text{BaCuO}_2 + \text{CuO}$ With $\text{Y}_2\text{O}_3$

947M0003B Moscow *NEORGANICHESKIYE MATERIALY* in Russian Vol 29, No 12, Dec 93 pp 1686-1690

[Article by M. I. Karpov, V. P. Korzhov, V. A. Zhukova, and M. M. Myshlyayeva, Solid State Physics Institute, Moscow; UDC537.312.62]

[Abstract] The title superconducting ceramic was synthesized by sintering the indicated eutectic with CuO (28 mole percent BaO + 72 mole percent CuO) and  $\text{Y}_2\text{O}_3$ . The superconducting ceramic had a specific current density of 400 Amp per  $\text{cm}^2$  at 77 K in a zero magnetic field. It contained two superconducting phases with critical temperatures of 98 K and 86-89 K. Figures 6; references 4: 1 Russian, 3 Western.

#### Effect of Non-Contact Interaction of Carbon with Melts of System $\text{Al}_2\text{O}_3\text{-ZrO}_2$ on Eutectic Composition

947M0003A Moscow *NEORGANICHESKIYE MATERIALY* in Russian Vol 29, No 12, Dec 93 pp 1648-1651

[Article by S. V. Belenko, V. A. Borodin, M. Yu. Starostin, and T. N. Yalovets, Solid State Physics Institute, Chernogolovka; UDC541.12.017]

[Abstract] Oxide-oxide ceramic eutectic composites are useful in fabricating components functioning at high temperatures, in aggressive media, or under mechanical stress. Alumina-zirconia stands out among traditional materials in having high hardness and resistance to wear. These properties also make it make it difficult to machine components made of these substances and for

this reason they are shaped directly by the Stepanov method of controlled crystal growth which requires no further mechanical handling. It was previously demonstrated that ceramic eutectics of the title composition, as prepared by the Stepanov method, may be used as structural materials, although mechanical testing demonstrated poor consistency in properties. Bending stress, for example, varied from 100 to 500 MPa. This low reproducibility in properties evidently results from contamination of the melt with carbon from the graphite heating zone. In the present work a study of the effects of the graphite heating elements on the composition of alumina-zirconia-ytterbia melts was made and certain measures are presented for lowering carbon contamination. Figures 2; references 10: 9 Russian, 1 Western.

#### **Cracking Liquid n-Hexane Under Action of UHF-Radiation**

947M0010B Moscow NEFTEKHIMIYA in Russian  
Vol 33, No 6, Nov-Dec 93 pp 557-563

[Article by M. S. Ioffe, E. A. Grigoryan, Structural Macrokinetics Institute, Chernogolovka; UDC661.716.3+537.528]

[Abstract] Activation of chemical reactions in the liquid phase with UHF-radiation has recently attracted the interest of researchers. It has been observed that organic compounds irradiated with UHF-energy in the presence of a sensitizer results in reactions giving products analogous to those of high temperature cracking (pyrolysis), and thus this process may be termed UHF-cracking. In the present work some results are presented on the UHF-cracking of liquid n-hexane, its mixtures with ethanol, and also UHF-cracking of n-hexane in the presence of other additives. The products were chiefly mixtures of light saturated and unsaturated hydrocarbons. It was demonstrated that with UHF-cracking of n-hexane at atmospheric pressure, the ethylene content in the products exceeded 44 mole percent. The presence of hydroxyl-containing additives suppresses processes leading to the formation of coke, so that the yield of useful products is practically unaltered. Figures 2; references 15: 5 Russian, 10 Western.

#### **Metal Content of Crudes from Afghan-Tadzhik Basin**

947M0010A Moscow NEFTEKHIMIYA in Russian  
Vol 33, No 6, Nov-Dec 93 pp 510-518

[Article by S. A. Punanova, T. A. Safranov, Geology and Exploitation of Fuel Minerals Institute, Moscow; Petroleum Geological Prospecting SRI, Dushanbe; UDC553.98]

[Abstract] The study of trace element compositions of crude oils has long since passed from purely theoretical considerations and now has heavy practical applications. The need for studying trace metal content in crudes is

important from the geochemical, metal ore, technological, economic, and ecological aspects. In the present work the distribution of trace elements in various crudes of the paleocenozoic incrustation of the Afghan-Tadzhik basin are discussed in conjunction with an evaluation of their metal content. Abnormally high concentrations of a number of trace elements, significantly exceeding the Clarke contents of the same elements in clayey deposits, are indicated. Trace element enrichment of the crudes is largely due to hypergenic transformation processes, since ore-bearing concentrations of trace elements are related to high viscosity, heavy, asphaltic crudes. The crudes of the Afghan-Tadzhik basin may serve as an alternative source of such metals as vanadium, nickel, copper, chromium, cobalt, and possibly others. Figure 1; references 10 (Russian).

#### **Selective Sorption of Trace Quantities of Gold From Sulfuric Acid Solutions by Crown Ethers**

947M0015A Moscow DOKLADY AKADEMII NAUK  
in Russian Vol 329 No 5, Apr 93 pp 608-612

[Article by V.V. Yakshin, O.M. Vilkova, N.A. Tsarenko, N.G. Zhukova, and B.N. Laskorin, academician, All-Russia Scientific Research Institute of Chemical Technology, Moscow; UDC 66.081:541.64:546.59]

[Abstract] Methods of extracting, concentrating, and purifying gold continue to receive a great deal of attention. As part of the continuing attempt to create new extractive reagents and sorbents that are more effective and selective than their existing counterparts, an attempt has been made to develop size-selective reagents containing two- and three-dimensional macrocyclic compounds (crown ethers and cryptands) as their active grouping. The distribution of gold in sorption systems containing polymeric crown ethers was studied by way of the example of model sulfuric acid solutions with a concentration of 0.5 to 9 mol/l HCl. Each model solution contained  $1 \times 10^{-3}$  percent of each of 25 elements: Al, Au, B, Ba, Bi, Ca, Cd, Co, Cr, Cu, Fe, Ga, In, K, Mg, Mn, Na, Ni, Pb, Sb, Sn, Sr, Ti, Zn, and Zr. Crown esters produced in the form of granulated spherical particles with a grain size of 0.3 to 0.6 mm were studied. Both macroporous and gel-type crown ethers were used. During the experiments, 0.1 g of polymeric crown ether was placed in contact with 10 ml of a model solution at a temperature of  $23 \pm 1^\circ\text{C}$  for 48 hours. The element content of each solution before and after sorption was determined on AESP-1 and ISAR-61 atomic emission spectrometers by using a specially developed method capable of detecting gold in concentrations as low as 0.04 ml/l with an error not exceeding 10 percent. As was initially hypothesized, the overwhelming majority of the elements included in the model sulfuric acid solutions behaved as in processes of extraction by monomeric crown ethers of analogous structure under comparable conditions. The gold, however, behaved quite differently in the sorption systems than it does during an extraction process. During the sorption process there was a virtually quantitative extraction of gold throughout the entire acidity range



from 0.5 to 9 mol/l HCl. Sorption of the gold peaked in the range from 1 to 3 mol/l HCl, where the highest gold distribution coefficient [ $D_{Au}$ ] values were observed for all of the crown ethers tested. The gel-type crown ethers did not extract gold or any of the other elements and were thus eliminated from further consideration. The porous-type sorbents extracted trace quantities of gold effectively; however, the value of  $D_{Au}$  was significantly dependent on both the sizes of the macrocycle in the polymeric crown ether and the type of attachment of the macrocycle to the polymer matrix. When the size of the macrocycle and number of oxygen atoms was increased in the series 18-crown-6, 21-crown-7, 24-crown-8 for one and the same type of polymeric crown ether,  $D_{Au}^{max}$  decreased from 2686 for the crown ether PDB18K6 to 2289 for PDB21K7 and 1190 for PBD24K8. All of the specified crown ethers had nearly identical amounts of active groupings within the confines of 2.0-2.1 mgEq/g, which indicated that crown ethers containing derivatives of the macrocycle 18-crown-6 as active groupings are the most effective sorbents of gold. The selectivity of the polymeric crown ethers tested was found to depend on both the dimensions of the functional macrocycle and the method used to fix it in the polymer matrix. Greater effectiveness in extracting gold (higher values of  $D_{Au}$ ) were accompanied by decreased process selectivity. The polycondensation-type sorbents, i.e., PDB21K7 and PDB24K8 produced by reacting crown ethers and formaldehyde, were found to offer the best compromise between effectiveness of extraction and selectivity in processes of sorption of gold from 0.5- to 2-mol/l solutions of HCl. Figure 1, tables 2; references 6 (Russian).

#### **New Photocatalysts: Dispersed Semiconductor Materials Having Microhetero Junctions**

947M0002C Kiev *TEORETICHESKAYA I  
EKSPERIMENTALNAYA KHIMIYA in Russian*  
Vol 29, No 3, May-Jun 93 pp 270-274

[Article by A. I. Kryukov, S. Ya. Kuchmiy, A. V. Korzhak, N. F. Guba, and S. V. Kulik, Physical Chemistry Institute imeni L. V. Pisarzhevskiy, Kiev; UDC541.145]

[Abstract] The development of effective photocatalysts is closely related to the search for ways to eliminate undesirable deactivation processes resulting in the dissipation of photoenergy into heat or luminescence whereby a significant portion of the light quanta absorbed by the photocatalyst is expended without inducing chemical reactions. In the case of semiconductor catalysts, the main deactivating process is recombination of generated photoexcited charges, i.e. electrons in the conductance zone and holes in the valency zone. Therefore, in considering the possibility of using any particular semiconductor as a photocatalyst, preference is usually given to materials in which electron-hole recombination is not well pronounced. In this respect, heterojunctions are of special interest. These are systems consisting of a semiconductor matrix with some other semiconductor material superimposed on its surface.

One special property of such semiconductor heterojunctions is their very efficient and in some cases irreversible ability to separate photogenerated electrons and holes by transferring one of these charge carriers or both from the semiconductor-matrix zone to the semiconductor-heterojunction zone, or vice versa. These semiconductors should have very high photocatalytic activity and indeed many have found practical applications as photodiodes, transistors, solar energy converters, etc. Currently available data on these heterojunctions refers mainly to dispersed coprecipitation products (cadmium and silver sulfides, copper (I) and cadmium, copper (I), cadmium, and zinc). The photocatalytic activity of these systems in hydrogen evolution reactions from aqueous sulfide-sulfite solutions is much higher than for the individual metals, which is attributed to the presence of microheterojunctions between similar semiconductors and the coprecipitation products. In the present work a study was made of the preparation and photocatalytic properties of heterojunctions made from cadmium sulfide and sulfur-containing heterocomponents formed from copper (I), copper (II), and bismuth (III) ions. Photocatalytic activity of the prepared semiconductors materials was studied for the reaction of molecular hydrogen evolution from alcohol-water suspensions. The studies demonstrated that the photocatalytic properties of these materials are largely comparable with the properties of cadmium sulfide, although there are some differences. All three materials containing  $Cu^+$ ,  $Cu^{2+}$ , or  $Bi^{3+}$  manifest a photocatalytic activity under light of the same spectral range as that of non-modified CdS, although in the case of hydrogen formation, the reaction proceeds at a considerably faster rate. Figures 1; references 6: 5 Russian, 1 Western.

#### **Electro-Chromic Properties of Aquapentacyanoferrate of Iron (III)**

947M0002B Kiev *TEORETICHESKAYA I  
EKSPERIMENTALNAYA KHIMIYA in Russian*  
Vol 29, No 3, May-Jun 93 pp 264-269

[Article by Yu. G. Goltsov, V. V. Zhilinskaya, V. B. Nechitaylo, V. I. Stepkin, Z. A. Tkachenko, and V. P. Sherstyuk, Physical Chemistry Institute imeni L. V. Pisarzhevskiy, Kiev; Physics Institute, Kiev; UDC546.722'267:546.723'267]

[Abstract] The development of new electrode materials from polymeric cyanoferrates is sustaining a steady interest. It has been demonstrated that hexacyanoferrate of iron (III), HCFI or Prussian Blue, is a promising substance for use in electro-optical devices using the electro-chromic effect and in electrical storage devices. HCFI is one of the most efficient converters of electrical charges in optical absorption and it has a high and stable coloration-discoloration rate. Modifications in composition and properties of polymeric cyanoferrates for the purpose of broadening their range of applications in

electronic devices operating in conjunction with other known electro-chromic materials, such as tungsten trioxide, remains a pressing problem. Recently, HCFI analogs having various extra-spherical cations have been prepared. An alternate method for modifying HCFI properties lies in substituting the ligands in the coordination sphere (cyanide ions), i.e. preparing a variety of pentacyanoferrates of iron (III). The significant differences between the physical chemical properties of the pentacyanide complexes and that of the highly symmetrical hexacyanides makes it possible to propose that a change in the symmetry of the ligand make-up of the iron atoms in the polymeric pentacyanoferrates must also have a significant effect on the physical chemical properties of the materials, including optical and electrochemical. In the present work an analog of Prussian Blue, aquapentacyanoferrate of iron (III), was prepared and a study was made of the effects of the composition of polymeric cyanoferrates on the physical chemical properties, structure, and electrochemical behavior of the resulting materials. Figures 2; references 10: 4 Russian, 6 Western.

**Electrically Conductive Polypyrrol Doped With Tetracyanoethylene Anion-Radicals**

947M0002A Kiev *TEORETICHESKAYA I EKSPERIMENTALNAYA KHIMIYA in Russian*  
Vol 29, No 3, May-Jun 93 pp 260-263

[Article by Ye. Yu. Skuridin, L. S. Degtyarev, and V. D. Pokhodenko, Physical Chemistry Institute imeni L. V. Pisarzhevskiy, Kiev; UDC 541.6+543.42+547.024]

[Abstract] The spin density wave (polaron) related to charge transfer along the chain of conjugated  $\pi$ -bonds of an electrically conductive polymer causes polarization of spin states. One approach to the study of these processes may be based on the utilization of a model polymer containing paramagnetic dopants. In the present work a study was made of the possibility of preparing and the properties of polypyrrole doped with tetracyanoethylene anion-radicals. A broadening in the EPR spectral line after introduction of the anion-radical was observed. This could have been caused by a slow spin-spin exchange between the radical and the polar polymer chain. Figure 1; references 6 (Western).



### Generalized Convolutional Block Concatenated Structures Based on PM4 Signals

947K0044A Moscow PROBLEMY PEREDACHI  
INFORMATSII in Russian Vol 29 No 4, Oct-Dec 93  
pp 11-17

[Article by V.V. Zyablov, S.A. Shavgulidze; UDC 621.391.15]

[Abstract] The use of concatenated systems as a coding standard for telemetry channels recommended by the Consultative Committee for Space Data Systems (CCSDS) whereby the code system consists of identical external Reed-Solomon (RS) codes and a single convolutional code with memory and free distance is discussed, and the possibility of realizing an additional energy gain in such systems using generalized concatenated codes is investigated in the case where there are eight external Reed-Solomon codes, and the total concatenated code length is 32,640 bits. The study shows that generalized convolutional block codes with different external Reed-Solomon codes are much better from the energy viewpoint than simple convolutional concatenated block codes. The structures based on quaternary phase modulation (FM4) which employ the property of signal system embedding and two different internal convolutional codes result in an additional energy gain, and the total energy gain compare to the CCSDS standard in the most optimum simulation and analysis points reaches 0.9 dB. The findings point toward the expediency of using the proposed generalized concatenated structures in channels with white Gaussian noise, particularly in space and satellite communications systems. Figures 3; tables 2; references: 6 Western.

### Dispersion Delay Lines using Surface Acoustic Waves with Phase Weighing

947K0033A Moscow RADIOTEKHNIKA I  
ELEKTRONIKA in Russian No 09, Sep 93  
pp 1710-1716

[Article by V. I. Grigoryevskiy, Ye. Yu. Zhdanov, A. I. Krikunov, D. V. Sokolov, S. B. Shashkin; UDC 621.37/39:534]

[Abstract] When developing dispersion delay lines (DDL) on surface acoustic waves (SAW) with 90° reflecting structures, in order to obtain amplitude-frequency characteristic of a specified form, a weighing is used by changing the position of individual reflecting elements. This method is called a phase weighing method. The method is based on lowering the amplitude of the reflected wave by shifting two adjoining elements into opposite directions. In this study, the phase weighing method was used for constructing DDL with slanted reflecting structures made with grooves. A diagram of such DDL using a SAW with inclined reflecting structures is provided. Two types of DDL made with  $\text{YZ-LiNbO}_3$  were constructed and their parameters and functioning is described. Interdigital transducers with equidistant electrodes were employed for the DDL. The

first type transducer contained four pairs of digits and the second type contained ten pairs. The amplitude-frequency characteristics and the shape of the compressed pulse at the output of both types of the DDL are shown in graphs. It was demonstrated that the method of phase weighing is very effective for obtaining the DDL amplitude-frequency characteristic of a specified configuration. Figures 5, references 9: 3 Russian, 6 Western

### A Radar Image Processing Method

947K0038A Moscow VESTNIK MOSKOVSKOGO  
UNIVERSITETA VYCHISLITELNAYA  
MATEMATIKA I KIBERNETIKA in Russian No 3,  
May-Jun 93 pp 34-40

[Article by D. A. Korotkov, Department of Mathematical Physics; UDC 517.958:[535+537.812]

[Abstract] A problem of determining the real characteristics of the Earth's surface from its radar image, obtained by a radar with a synthesized aperture is examined in this article. The radar located on an aircraft moving in a straight line at a constant elevation scans a section of the Earth surface in a projection mode, where the transmitting and the receiving antennas are continuously directed to this section. The transmitting antenna radiates a probing signal, consisting of two electromagnetic waves with a parallel and perpendicular polarization; the receiving antenna records a signal, which is a combination of two waves generated by scattering of the probing signal by the Earth's surface. The problem consists of finding the scattering coefficient from the known radiating and received signals. With this information the Fourier form of the  $f(x,y)$  projection and the projection itself can be determined, but only for a narrow angular section. In order to reconstruct the  $f(x,y)$  function for the entire region, a method is developed for determining the scattering coefficient as a function of the characteristic of the Earth surface with a radar, making it possible to compute the desired coefficient using the data from a partial angular section, applying effective algorithms. Figures 2, references 8 Russian.

### Analysis of Electron Confinement in a Semiconductor Periodic Structure

947K0035B Moscow KVANTOVAYA ELEKTRONIKA  
in Russian Vol 20, No 9, Sep 93 pp 846-850

[Article by P. G. Yeliseyev, P. V. Karga; UDC 621.373.826.038.825.4]

[Abstract] A comprehensive analysis has been performed in this article of the feasibility of employing periodic quantum-size heterostructure (QHS), or multiquantum barrier (MQB), based on  $\text{Al}_x\text{Ga}_{1-x}\text{As}/\text{GaAs}$  and  $\text{Ga}_x\text{In}_{1-x}\text{As}/\text{P}_{1-x}\text{InP}$  for improving the efficiency of electron confinement in the active region of semiconductor laser and reducing the current density of the electron leakage from the active zone. Parameters of the periodic MQB

were determined, where the height of the effective potential barrier was increased by more than 100%, and the density of the current leakage from the active region of the semiconductor laser was decreased by more than three orders of magnitude. The relationship of the electron wave reflection coefficient as a function of the electron energy, and behavior of the current density of electrons injected into the active region in the above heterostructures, with variation of the number, composition and thickness of the layers which form the periodic MQB was analysed. Figures 5, references 8 Western.

### InAsSb/InAsSbP Injection Lasers for High Resolution Spectroscopy

947K0035A Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 20, No 9, Sep 93 pp 839-842

[Article by Yu. P. Yakovlev, A. N. Baranov, A. N. Imenkov, V. V. Sherstnev, Ye. V. Stepanov, Ya. Ya. Ponurovskiy; UDC 621.373.826.038.825.4]

[Abstract] Experimental results are described demonstrating the feasibility of developing frequency tunable in the  $\lambda=3.2-3.4 \mu\text{m}$  spectral range semiconductor injection InAsSb/InAsSbP lasers. The laser structures were prepared using the method of liquid phase epitaxy on a InAs substrate, oriented in the (100) plane. The narrow-band region contained  $\text{InAs}_{0.96}\text{Sb}_{0.04}$ , so that at the temperature of 77K, the width of the prohibited zone was  $E_g=0.383 \text{ eV}$ , and the reflection index was  $n_0=3.54$ . This type lasers were employed at temperatures from 77 up to 160K for a high resolution molecular spectroscopy. The most important spectroscopic properties of the lasers were obtained from the absorption spectra of methane and ethylene molecules. Figures 5, references 7: 4 Russian, 3 Western.

### The Effect of Photoabsorption Convection on the rate of cw CO<sub>2</sub>-Laser-Induced Chemical Vapor Deposition of Amorphous Hydrogenated Silicon

947K0035G Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 20, No 9, Sep 93 pp 925-932

[Article by A. A. Deryugin, G. V. Mishakov; UDC 621.373.826]

[Abstract] The rate of sedimentation as a function of geometrical parameters, such as the beam diameter and distance between the beam axis and substrate, was examined for the conditions of laser-chemical deposition of silicon from a mixture of monosilane with argon under the effect of continuous CO<sub>2</sub> laser. Procedures are described for measurements of the deposition rate. To minimize the edge effect of the heater measurements, depending on the distance between the beam and the substrate the measurements were made at the same beam section. The chemical kinetics in this case is primarily determined by the gas temperature, therefore, to a great extent, the problem of the rate and the deposition conditions can be solved by examining the distribution

of gas temperature in the reactor volume, depending on the parameters of the experiment. The direct measurements of the gas temperature near the laser beam were compared with the results of numerical computations of the temperature fields in the cavity, produce by an electric heater of the substrate as well as by the gas absorption of the laser radiation. Based on the experimental results and data in the literature, it can be concluded that a developed photoabsorption convection is being developed under the examined conditions, which significantly changes the temperature field in the cavity. It is apparent that for construction of an adequate theoretical model of laser-chemical deposition, the convection must be taken into the account under the examined conditions. Figures 13, references 22: 15 Russian, 7 Western.

### The Kinetics of Bleaching and Induced Absorption in CuInS<sub>2-x</sub>Se<sub>2(1-x)</sub>-Doped Glasses Under a picosecond Excitation

947K0035E Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 20, No 9, Sep 93 pp 893-898

[Article by K. V. Yumashev, V. P. Mikhaylov, I. V. Bodnar, M. I. Demchuk, P. V. Prokoshin, V. S. Gurin, S. P. Zhmako; UDC 621.373.826]

[Abstract] Nonlinear-optical properties of glasses with microcrystals of a semiconductor compound  $\text{CuInS}_{2-x}\text{Se}_{2(1-x)}$  (belonging to the  $A^1B^3C^6_2$  type), whose edge of the fundamental absorption band lies in the near infrared spectral region ( $1-1.4 \mu\text{m}$ ), were experimentally examined in this paper. The relationships of energy transmission as a function of peak intensity of the incident ultrashort pulses (USP), and the kinetics of changes in absorption of the exploring USP at different intensities of the excitation radiation and the width of the prohibited zone were also studied. Single USP of the fundamental and second harmonics of YAlO<sub>3</sub>:Nd laser with a passive synchronization of the modes were used as the excitation source and for probing. The USP duration was about 15 ps.  $\text{CuInS}_{2-x}\text{Se}_{2(1-x)}$  microcrystals, dispersed in a silicate glass, with 1.06, 1.14, 1.17, and 1.22 eV width of the prohibited zone were examined and the results are shown in a graph. The experiments demonstrated that in glasses containing semiconductor microcrystals  $\text{CuInS}_{2-x}\text{Se}_{2(1-x)}$ , the character and time parameters of the kinetics of the absorption changes, induced by picosecond light pulses, depend on the excitation level, and also on the photon energy of the excitation and probing pulses. Figures 6, tables 2, references 9 Russian

### Passive Synchronization of the Modes of Neodymium Lasers Using CuInS<sub>2-x</sub>Se<sub>2(1-x)</sub>-Doped Glasses

947K0035D Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 20, No 9, Sep 93 pp 890-892

[Article by K. V. Yumashev, V. P. Mikhaylov, I. V. Bodnar, M. I. Demchuk, P. V. Prokoshin, R. S. Dashyan; UDC 621.373.826.038.825.2]

[Abstract] Passive synchronization of the modes of YAG:Nd and  $\text{YAlO}_3$  lasers using  $\text{CuInS}_{2x}\text{Se}_{2(1-x)}$ -doped glasses is discussed. The optical block diagram of the laser is provided and its functioning is described. The laser resonator is formed by a spherical mirror and a planar output mirror. A passive synchronization of modes was obtained when glasses with  $\text{CuInS}_{1.5}\text{Se}_{0.5}$  monocrystal were used as passive gates in pulsed solid state neodymium lasers. The pulse width was 36 and 16 ns for the YAG:Nd and  $\text{YAlO}_3$ :Nd lasers, respectively. The passive gates operate as saturating absorbers at low intensities and perform negative feed-back at high radiation intensities. The glasses with  $\text{CuInS}_{2x}\text{Se}_{2(1-x)}$  are a promising material for semiconductor cavity saturating absorbers for solid state lasers operating in a self-starting mode. The saturating absorbers exhibit a rapid relaxation, and have low losses and high saturation intensities. They can operate in a nonlinear mode within resonators of solid state lasers, interacting with pulse intensities in a pico range. The required operating wave length can be selected within the 0.9-1.3  $\mu\text{m}$  range by changing the stoichiometry coefficient and composition of the glass. Figures 4, references 11: 4 Russian, 7 Western.

#### Excitation States, Photo-physical Properties and Structure of the Junction of a Complex Molecule 1.4-Phenilen-2,2'-Bisoxazol

947K0035C Moscow KVANTOVAYA ELEKTRONIKA  
in Russian Vol 20, No 9, Sep 93 pp 863-873

[Article by A. Ye. Obukhov; UDC 535.37+621.373]

[Abstract] Photophysical properties of a new complex active molecule 1.4-phenylen-2,2'-bisoxazol (OPO) were examined. This molecule is capable of fluorescence and light generation in the wavelength region  $\lambda=340-420\text{ nm}$  with a high quantum efficiency of fluorescence  $\gamma=0.45-0.93$  and low threshold pumping density in different solvents. It was demonstrated that the solvent affects the localization of the electron density of the atoms and fragments of the complex OPO molecule in the fundamental state. Because of changes in the distribution of the length of linkages in the cycles of the OPO molecules, when the hydrogen atom attacks the individual pair of electrons of the nitrogen atoms, the structure of excited electron singlet ( $S_1^*$ ) and triplet ( $T_1$ ) states and transitions, determining the photophysical characteristics of the complex compounds is changing. Spectral fluorescence and generation characteristics of the complex heteroatomic molecule OPO in different solvents and in a gas phase were measured and computed. It was also demonstrated that increasing or decreasing of the pumping density in vapors, or changing the solvent properties, is related to a dynamic separation or overlapping of the light generation bands on transitions. A feasibility is demonstrated that the a priori structural modeling method can be used for controlling the properties of the excited states and junctions. Figures 4, tables 3, references 53: 40 Russian, 13 Western.

#### Multiplexed Fiber-Optic Sensors with Autodyne Detection

947K0035F Moscow KVANTOVAYA ELEKTRONIKA  
in Russian Vol 20, No 9, Sep 93 pp 903-913

[Article by V. T. Potapov, A. M. Mamedov, S. V. Shatalin, R. V. Yushkaytis; UDC 681.586:681.7.068]

[Abstract] A method is proposed for construction of multiplex systems of fiber-optical interferometric sensors entirely without optical directional couplers. In these systems, the signal waves are formed by reflecting a portion of the radiation, propagating in the fiber lightguide, from semi-transparent mirrors, built within it, or from the internal nonhomogenieties of the lightguide itself. When they arrive back into the laser cavity, the lasing amplitude changes. Small changes in the length of the optical path in the lightguide, caused by the physical effects, which are being examined, can be detected by controlling the laser output. Theoretical relationships are developed for a frequency-modulated laser with optical feedback and the carrier frequency modulation method for multiplex sensors is discussed. Modulation characteristics of a He-Ne laser, the bistability of the longitudinal modes are examined and the effect of cross-talk is estimated. Autodyne multiplex sensors including underwater acoustics antenna and temperature sensors are also briefly discussed. The experimental study of frequency-scanned He-Ne-laser operating with different lightguide systems demonstrated that an autodyne detection is suitable for application with distributed sensors employing a Rayleigh scattering signal. Figures 9, references 12: 4 Russian, 8 Western

#### Application of the Statistical Properties of Radiation for Perfect Calibration of Photodetectors

947K0034A Moscow RADIOTEKHNIKA I  
ELEKTRONIKA in Russian No 09, Sep 93  
pp 1704-1709

[Article by Ye. V. Lesnikov, V. I. Pustovoyt, A. A. Khrimyan; UDC 621.373.826]

[Abstract] A method for determining the quantum effectiveness of photo-detectors is described. This method is based on the analysis of the photocurrent dispersion fluctuations with a priori specified statistics of the radiation field. Thus, the spectral sensitivity of the photo-detector can be determined with a single electron formation process of the photocurrent. A device for experimental determination of the effectiveness of a silicon photodiode FD-7K was constructed. Its block diagram is provided and the experimental procedures are described. Light-emitting diodes AL-307 and AL-107, with  $\lambda_{\text{max}}=0.67$  and  $0.95\text{ }\mu\text{m}$ , respectively, were used as sources of radiation. Before determining the quantum effectiveness of the photo-detector, curves of



the shot current dispersion for different radiation intensities were first obtained, and are shown in a graph. Figures 2, table 1, references 11: 5 Russian, 6 Western.

### Photodetectors Using $A^{III}B^V$ Compounds for Integrated Microcircuits with Optical Linkages

947K0032I Novosibirsk AVTOMETRIYA in Russian  
No 3, May-June 93 pp 73-77

[Article by V. F. Andriyevskiy, P. P. Aslamov, T. O. Budko, Ye. V. Gushchinskaya, E. V. Zaporozhets, S. A. Malyshev, M. P. Ryzhkov, V. S. Shevtsov; UDC 621.315.592.2:621.383.5:621.38.049.774]

[Abstract] Photo-detectors based on gallium arsenide and indium phosphide are examined in this paper. These photodetectors are suitable for operation in a structure of three-dimensional integrated microcircuits with optical linkages. Of the familiar types of GaAs photodetectors, the metal-semiconductor-metal (MSM) photodetectors are the most attractive from the point of view of being able to obtain ultimately high speed and sensitivity, and because of their technological compatibility with the fundamental element of GaAs integrated circuits - the field effect transistor. The structure of the examined MSM-photodetector is described and its spectral characteristic is shown in a graph. As shown in the curves, the maximum spectral sensitivity is located at the absorption edge of the gallium arsenide ( $\lambda_1=0.87$ , where a sharp peak is observed). The second maximum appears at  $\lambda_2=1.2-1.3$   $\mu\text{m}$ . Presence of two spectral photo-sensitivity regions with different characteristic times, offers an additional capacity for controlling the information flow using two wave-lengths. Results of studying the indium phosphide photodiodes are discussed and graphs showing their cross section and topology, as well as their volt-ampere characteristic are provided. The spectral characteristic of an InP photodiode is also shown in a graph. Figures 7, references 9: 4 Russian, 5 Western

### Thin-Film Dielectric Light Polarizer

947K0032H Novosibirsk AVTOMETRIYA in Russian  
No 3, May-June 93 pp 68-72

[Article by V. N. Beltyugov, S. G. Protsenko; UDC 621.382]

[Abstract] A thin-film dielectric light polarizer is proposed for analysis and control of polarization conditions. The polarizer performance is based on the earlier established phenomenon of polarization anisotropy of optical characteristic of the dielectric layer with corrugated edges. Unlike the existing thin-film dielectric polarizers, the proposed optical element is a relatively simple construction intended for operation under a normal angle of incidence. For experimental testing of the proposed device, samples of dielectric polarizer were constructed and its function is described. The experiments demonstrated a feasibility of developing thin-film polarization element based on a dielectric layer with

corrugated edges. Compared to the polarization structures made of metal, the technology of constructing corrugated structures on the surface of a dielectric is more simple, while polarization efficiency of the tested samples was sufficient for application with some optoelectronic devices. Figures 4, references 4: 2 Russian, 2 Western.

### Thin-Film Photoresistors Using $A^{III}B^VI$ Compounds for Three-Dimensional Optoelectronic Processors

947K0032J Novosibirsk AVTOMETRIYA in Russian  
No 3, May-June 93 pp 78-81

[Article by A. S. Vedenin, A. S. Posedko, Yu. V. Trofimov; UDC 681.325.5:621.3]

[Abstract] Features of employing  $A^{III}B^VI$  semiconductor compounds, specifically cadmium sulfide-selenide, in a form of thin-film photodetector structures, are examined for different elements of optoelectronic processor. A technology was developed in the Belorus Academy of Sciences for obtaining thin-film photo-resistors based on cadmium sulfide-selenide, which includes: a cathode three-electron scattering on direct current and high frequency voltage of a cold-pressed target, activation of photo-sensitivity by thermal processing of films in the original batch, photo-lithographic operations for obtaining the required topology of micro-elements on thin-film of cadmium sulfide-selenide and In -  $A^{III}B^VI$ , Al - Ti -  $A^{III}B^VI$  contact systems. Thin-film photo-resistor structures 0.5-2.0  $\mu\text{m}$  thick can be formed with this technology on different substrates with a sufficiently high photoelectric quality. Experimental data are provided, supporting the feasibility of application of thin-film photo-resistors based on cadmium sulfide-selenide for modeling and development of three-dimensional optoelectronic processors. Figures 3, references 5: 3 Russian, 2 Western.

### Electrooptic Memory Medium Based on Thin Ferro-electric Films

947K0032F Novosibirsk AVTOMETRIYA in Russian  
No 3, May-June 93 pp 53-63

[Article by E. G. Kostov; UDC 537.226]

[Abstract] Electrooptical effect in thin ferro-electric films of strontium barium niobate (SBN)  $\text{Ba}_x\text{Sr}_{1-x}\text{Nb}_2\text{O}_6$  and features of its application as a reversible memory medium with electro-optical information reading, when the state of the medium element is determined by the polarization direction in the ferro-electric material were examined. The electrophysical characteristics of this medium are discussed. This ferro-electric material was selected because in addition to other high electro-optical parameters it exhibits other qualities: a high melting temperature, small values of piezoelectric losses, time



stability of the samples, a high value of dielectric constant, etc. Thin-film ( $\text{In}_2\text{O}_3 + \text{SnO}_2$ ) - SBN film - ( $\text{In}_2\text{O}_3 + \text{SnO}_2$ ), obtained by high frequency sputtering method on sapphire substrates were used for the studies. Based on comparative analysis of different contemporary methods for obtaining multi-component 2-5  $\mu\text{m}$  thick ferroelectric films, it can be assumed that at the present time the high frequency sputtering is a preferred method. Figures 5, references 39: 12 Russian, 13 Western.

### 3-D Integrated Optical Associative Memory Circuits

947K0032E Novosibirsk AVTOMETRIYA in Russian  
No 3, May-June 93 pp 44-52

[Article by V. I. Kozik, P. Ye. Tverdokhleby; UDC 681.325.65:535.232.65]

[Abstract] A method for designing an optical associative memory device (OAMD) in the form of an integrated microcircuit using electro-optical thin-film modulators, integrated-optical splitter, and a light beam integrator is proposed. Estimates are made of the fundamental parameters of the microcircuit. It is demonstrated that the OAMD can be made in the form of a multilayer thin-film structure with optical interconnectors. Works are carried out now at the Institute of Automatics and Electrometry practically in all directions of the microcircuit development. Different models of light beam splitter are being studied. A splitter mock-up is developed for 16 light beams exhibiting a nonuniformity of diffraction efficiency smaller than 5%. Technology is mastered for producing high-efficiency diffraction optical elements. Ferroelectric films of strontium barium niobate are synthesized. A construction is proposed of a thin-film light polarizer with the polarization ratio of 50:1. Experimentally, a 20:1 ratio was obtained. Figures 6, references 16: 9 Russian, 7 Western.

### Three-Dimensional Neural-Like Optical Computing Structures

947K0032A Novosibirsk AVTOMETRIYA in Russian  
No 3, May-June 93 pp 38-43

[Article by V. M. Yegorov; UDC 621.382]

[Abstract] Several options for parallel optical linkages between simple two-layer neural-like uniform computing structures, based on a light modulator - photodetector couple are examined. Two design methods of optical multilayer three-dimensional computing devices are possible: With the first method, the complex functional circuits, made for each layer using the traditional silicon p-n-technology are connected to each other by optical information channels. With the second method, the layers are formed based on simple optical logic circuits. The advantages and disadvantages of both methods are discussed. Block diagrams and functional circuits of the structures and samples of parallel computations including simultaneous storage of the results and initial information are provided with the text. The examples of two-layer

optical computing structures are functionally not perfect, but a combination of such devices in multilayer computing structures increases their functional capacity and flexibility by a several orders of magnitude, and can be effectively employed for binary and neural computations. Figures 5, references 5: 4 Russian, 1 Western

### Neural Network Realization of a Sorting Algorithm Using a Three-Dimensional Optical Neural-Chip

947K0032C Novosibirsk AVTOMETRIYA in Russian  
No 3, May-June 93 pp 28-37

[Article by V. R. Grigoryev, S. P. Naumov; UDC 681.325]

[Abstract] A structural circuit of a neural network employing an algorithm for sorting a sequence of n-numbers is examined. The structural circuit takes into account the limitations concerning engineering implementation of the proposed circuits on an optical neural chip. The examined structural circuit was modeled as a package of computer programs. The circuit consists of an adaptive neural network, whose weight coefficients are adjusted depending on the input data. Modeling of the neural network for  $n=256$  with a program package allowed to experimentally test the convergence of the proposed neural algorithm and to verify the obtained analytical time estimates of its performance. With the contemporary technology of VLSIC, it is possible to develop neural chips capable of sorting 512 numbers during a single cycle. Figures 9, references 18.

### Electro-optic Realization of a Cell Multiplier

947K0032B Novosibirsk AVTOMETRIYA in Russian  
No 3, May-Jun 93 pp 14-27

[Article by V. P. Markova; UDC 621.382]

[Abstract] Based on the methods of parallel microprogramming, a method is proposed for transformation of a two-dimensional structure into a three-dimensional. Two options are described here of the proposed multiplication algorithm of two integer n-digit numbers with a fixed comma. Using these algorithms, structural multiplier circuits on electrooptical programmable logic array (PLA) are designed with a different number of layers  $k > 2p$ , where p is the number of logic layers, and the complexity of their implementation are estimated. The fundamental concepts of parallel microprogramming and the basic multiplication algorithm of integer n-dimensional numbers are described. Single layer electrooptical models of the proposed and the developed multipliers are discussed. Different stratification options of the multipliers and the difficulties involving their realization with electrooptical programmable logic arrays are also discussed. Figures 7, tables 4, references 17: 13 Russian, 4 Western.

## AVIATION AND SPACE TECHNOLOGY

### Electrophysical Properties of Heterogeneous Composites in High-Frequency Region of Electromagnetic Field

947F0050A Moscow *IZVESTIYA ROSSIYSKOY AKADEMII NAUK: ENERGETIKA* in Russian No 6, Nov-Dec 93 pp 59-84

[Article by A.N. Lagarkov, Moscow; UDC 621.]

[Abstract] The proliferation of today's composite materials consisting of heterogeneous mixtures of various particles bound by a common matrix in aerospace engineering, modern microwave devices, nonlinear composite resistors, and high-temperature heaters necessitated an investigation into the electrophysical properties of such materials in RF fields. To this end, the behavior of dielectric permittivity and magnetic permeability is examined in greater detail; in particular, the random frequency variance of the dielectric constant, the dependence of the static conductivity of a nonordered mixture of insulator and conductor particles on the relative bulk concentration of conducting particles, the behavior of the dielectric constant and conductivity as a function of concentration, the frequency dependence of the effective dielectric constant and magnetic permeability and their real and imaginary parts, etc., are plotted. Attention is focused on the behavior of these constants near the conductivity threshold in electromagnetic fields allowing for the electromagnetic field skinning. The use of quasi-circuit systems for attaining high dielectric constants in RF fields is addressed. It is noted that the scope of the paper makes it virtually impossible to describe numerous properties inherent in composite structures in the RF spectrum since there are no natural materials capable of even marginally meeting the broad range of today's needs. It is speculated that the development of future materials will require further development of both a comprehensive body of theoretical data and adequate practices which realize complex spatial structures. Figures 28; references 34: 10 Russian, 24 Western.

### Zont-M Helicopter Deck Landing Signal Generating System

947F0052A St. Petersburg *SUDOSTROYENIYE* in Russian No 7 (668), Jul 93 pp 27-28

[Article by I.M. Okon, Yu.P. Tyumenev; UDC 629.12:628.92/97-52]

[Abstract] The Zont-M complex which generates the helicopter landing light control system (STO) signals on a ship or drilling rig is described. The Zont-M system generates 0.3 A, 27 V direct current signals and transmits them to the floating drilling rig (PPBU) or ship deck and 0-10 V DC signals matched to a 10 k $\Omega$  load for the on-board computer. The Zont-M system generates control signals which are proportionate to the angle of roll within  $\pm 10^\circ$  at a  $1^\circ$  step, to the change in the angle of

roll, to the angle of trim within  $\pm 5^\circ$  at a  $1^\circ$  step, and to the change in the angle of trim, as well as a signal indicating the change in the direction of the vertical linear velocity component perpendicular to the deck plane. Operation of the system requires data on the pitching, rolling, heaving, and yaw angles from such external sources as vertical gyro or synchro resolver. The system ensures the necessary accuracy (0.5° roll and trim, 0.2 m heaving, and 0.2 m/s linear velocity component) in rough seas of up to force 5 within a 0-40°C temperature range at speeds of up to 20 knots. A block diagram of the Zont-M system and its front panel are cited, and the operating procedure is outlined in detail. The system uses 150 W, 220 V, 50/60 Hz power supply, and its electric circuits are executed on 4-mm thick 220x130 mm boards and are splashproof. The system meets all Register specifications. Figures 2; references 1.

## NUCLEAR AND NON-NUCLEAR ENERGY

### Plan for Erecting Experimental Solar Electric Power Plant in Kislovodsk

947F0056A Moscow *ENERGETICHESKOYE STROITELSTVO* in Russian No 7, Jul 93 pp 35-39

[Article by A.A. Chernyavskiy, candidate of technical sciences, and A.G. Manuylenko, Yu.D. Kapustin, and M.A. Kovalenko, engineers, Rostov Oblast Institute for the Design and Planning of Electrical Equipment for Heat Engineering Installations [Teploelektroproekt]; UDC 621.472]

[Abstract] The Russian state scientific-technical program "Ecologically Pure Power Generation" calls for the development of a plan to erect an experimental solar electric power plant in Kislovodsk. The Rostov Teploelektroproekt has been named general designer of the new solar electric power plant, and the Power Engineering Institute imeni G.M. Krzhizhanovskiy has been put in charge of creating it. The planned 1.5-MW-capacity modular solar electric power plant will be used to partially cover the electricity and heat demand of users in the plant's vicinity. The plant will consist of two independent parts: The first will convert solar radiation into electricity by using solar batteries based on silicon single crystals and polycrystals, and the second part (the thermodynamic part) will use Stirling motor-generators (i.e., electrical generators connected to a Stirling motor that is excited by solar radiation) as converters. The new solar electric power plant includes the following components: four fields of solar photoelectric modules; two fields of solar modules with Stirling motor-generators; a field of solar water-heating modules; three inverter substations; and control, regulation, protection, and automation systems. The station's circuit includes three independent solar power units that are connected through transformers to a common system of station generator buses. Together, the solar modules' design peak capacity is 1,907 kW<sub>e</sub>. The new solar electric power

plant's basic technical-economic indicators are as follows: peak intensity of solar radiation flux, 0.9 kW/m<sup>2</sup>; number of hours of sunshine annually, 2,147; total yearly solar radiation, 1,345 kWh/m<sup>2</sup>; peak electrical capacity, 1.6 MWh; peak thermal capacity, 10.5 MW; yearly output of power to consumers, 1,560 MWh of electricity and 46,000 GJ of heat; average thermal efficiency of the solar modules, 57 percent; total area occupied by the fields of solar modules, 10.7 hectares; area of the solar modules' active receiving surface, 35,280 m<sup>2</sup>; specific capital investments per unit power, 6,770 rubles/kW for electricity and 5,000 for heat; cost of producing electricity, 34.8 kopecks/kWh; cost of producing heat, 76.5 rubles/GJ; and number of servicing personnel required, 64. The new solar electric power plant has a design service life of 30 years, and the electricity and heat produced by it should reduce wastes released into the environment by the following amounts: 7,000 tons of ash; 18,000 tons of carbon oxides; 1,400 tons of nitrogen; and 3,800 tons of sulfur. The new solar electric power plant should also reduce heat emissions by  $7 \times 10^8$  J and should conserve the 12,000 tons of atmospheric oxygen conventionally required to burn fossil fuel in boiler furnaces. The new Kislovodsk solar electric power plant is slated to be completed in 1996. Figure 1, table 1; references 8: 2 Russian, 6 Western.

#### **Conclusion to 'Conception for Development of Nuclear Power Industry in Russian Federation'**

947F0055A Moscow *ENERGETICHESKOYE STROITELSTVO* in Russian No 7, Jul 93 pp 9-18

[Abstract of article detailing the conclusions of a group of experts created by A.V. Yablokov, advisor to Russia's president on matters of ecology and health protection, regarding three documents concerning the Russian Federation's policy on nuclear power; group members: I.A. Bashmakov, candidate of economic sciences, Ye.B. Burlakov, doctor of biological sciences, I.G. Gritsevich, candidate of economic sciences, A.V. Dyakov, candidate of physical and mathematical sciences, V.M. Maslennikov, candidate of technical sciences, D.P. Osanov, doctor of technical sciences, L.V. Popov, doctor of technical sciences, N.M. Raddatis, candidate of physical and mathematical sciences, S.Ya. Chernavskiy, candidate of technical sciences, S.I. Zabelin, candidate of technical sciences, and S.K. Revina, candidate of chemical sciences]

[Abstract] The "Conception for the Development of the Nuclear Power Industry in the Russian Federation Under the New Economic Conditions" was approved by the Russian government on 10 September 1992. A group of experts examined the policy statement and drew a number of conclusions regarding it. The group's overall conclusion was that the scales assumed regarding the development of nuclear energy for the production of power and heat are based on a single unfounded scenario for the future development of Russia's economy and power industry. The group went on to suggest that the policy statement be rejected in its present form and

revised to include a special program of emergency measures to prevent the possible occurrence and development of large-scale accidents at now-operational nuclear power facilities until they are shut down and to reduce the harmful environmental effects of stored radwaste and spent nuclear fuel during its storage and reprocessing. Included among the other points raised in the group's 11-point reaction to the policy statement were the following: 1) the policy statement does not acknowledge the existence of alternative, economically sounder versions of covering that portion of Russia's future power demand that is slated to be covered by nuclear power; 2) the assessment of the current status of Russia's nuclear power industry presented in the policy statement significantly distorts the true state of the industry and paints it in a manner favorable to the RF Ministry of Atomic Energy; 3) the extensive program of construction of new nuclear power facilities, including facilities with RBMK reactors, in all parts of the country called for in the policy statement is unacceptable; 4) the ecological arguments in favor of expansion of the nuclear power industry (especially the argument that increased use of nuclear power will result in decreased burning of fossil fuel) that are included in the policy statement are not, either individually or in their entirety, sufficient grounds for further expanding nuclear power generation in Russia by 2000-2010; 5) the harmful effects of nuclear power generation on the environment, both because of accidents and because of flaws in the technology, are well known and eliminate any basis for the statement that atomic energy is safe on an ecological plane; 6) Russia's unified electric power systems are sufficient to meet her fuel and power demands for several decades without any need to increase her nuclear power industry; 7) the projected cost estimates of the proposed plan for augmenting Russia's nuclear power industry are unfounded because, as previously stated, the plan only considers one possible scenario; 8) Russia has a broad spectrum of alternatives to expansion of its nuclear power industry (including controlling heat use in the domestic and industrial sectors, redesigning new gas-fired boiler units to produce electricity and heat in the form of steam and hot water, equipping existing steam turbine units with gas turbine-based topping stations, and increasing the use of coals from the Kansk-Achinsk and Kuznetsk basins; 9) the policy statement largely ignores international experience in the area of nuclear power plant construction; 10) the policy statement does not provide any mechanism for the public's involvement in decisions regarding constructing nuclear power enterprises or for providing the public with objective information regarding Russia's radiation situation. Tables 2.

#### **Optimum Control of Gas Main Operating Conditions**

947F0049B Moscow *IZVESTIYA ROSSIYSKOY AKADEMII NAUK: ENERGETIKA* in Russian No 6, Nov-Dec 93 pp 120-123

[Article by P.A. Matevosyan, E.S. Safaryan, A.L. Oganisyan, Dilizhan and Yerevan; UDC 622.691.4]



[Abstract] Reports that optimum gas transport control of a gas main may help lower the power consumption for housekeeping needs by up to 1% prompted the development of a principally new technique and mathematical model and algorithms for on-line optimum control of the gas main operating conditions in the case with successively positioned compressor stations equipped with centrifugal gas transfer plants (GPA). The desired effect is achieved by ensuring the optimum compressor station inlet and outlet gas pressures with changes in the gas flow or other transported gas parameters. The technique for on-line control of the gas main (MG) operating conditions is described in detail; three stages are considered: developing the optimum energy-economic characteristics (EEKhKS) for each compressor station (KS), establishing the optimum gas pressures on the basis of the mathematical model of the gas main and the above optimum compressor station energy-economic characteristics, and establishing the optimum inlet and outlet gas flows transported through the transfer plants at each compressor stations. It is suggested that the models be implemented on microcomputers which may be placed at dispatcher control centers and that changes in the process parameters be taken into account directly in the course of operation. Figures 2; references 5.

## INDUSTRIAL ENGINEERING

### Assembly Manipulator

947F0041B Moscow AVTOMATIZATSIYA I SOVREMENNYE TEKHNologii in Russian No 7, Jul 93 pp 4-6

[Article by I.A. Bostan, I.G. Botez, and V.Ye. Dulgeru; UDC 621.757:002.72]

[Text] The manipulator is a mechanical structure with a large number of articulated elements and, as a rule, a large number of degrees of freedom. In a perfect structure, such a manipulator may assume any shape in the three-dimensional space. This exceptional flexibility makes it possible to employ manipulators in various fields of industry where the maneuverability space is highly constrained.

This flexibility engenders new problems: how to monitor each element when the arm is moving within a constrained space with obstacles and eliminate collision with them, what is the optimum control of various arm elements which can realize the necessary trajectory, etc.?

It is obvious that in order to improve this manipulator's maneuverability, the number of elements must be quite high. Assuming that each element has two-to-three degrees of freedom relative to the preceding one, it becomes necessary to use a large number of actuators and devices which leads to an increase in its mass and worsens the manipulator's technical characteristics, such as its speed of response, positioning accuracy, load-bearing capacity, etc. The solution to this problem amounts to positioning actuators beyond the elements

and transmitting energy to a distance with the help of an adequate mechanical, pneumatic, or electric system.

An original simplified manipulator design (Figs. 1a and b) and an analysis of some of its parameters are presented in this article.

The manipulator contains base 1 which houses the following: stepping electric motor 2 and precision reduction gear 3 containing a satellite gear cluster 4 consisting of roller gear rims 5 and 6 and sun gears 8 and 9 installed on crank 7. Gear 8 is linked to the base while driven sun gear 9 with gear-type coupling 10 and clutch 11 is linked to the first link 12 after the base. The manipulator also contains moving links 13-15 connected to each other by ball and socket joints 16-18. Flexible tie 19 one of whose ends is connected through spring 20 to link 15 and the other end—to the screw of the ball and screw transmission 21 located in the hub of the driven sun gear 9 passes through moving links 12-15. Each moving link 12-15 is connected to the flexible tie by a centering mechanism.

Each centering mechanism is executed as two controlled fixtures: controlled fixtures 22 and 23 are installed in link 13, controlled fixtures 24 and 25 are installed in link 14, and controlled fixtures 26 and 27 are installed in link 15. The screw of the ball and screw transmission is connected to link 12 by the second clutch 28 while link 12 is connected to the flexible tie by controlled fixture 29. Each controlled fixture is executed as an electromagnet whose core is articulated with the flexible tie.

The manipulator operates as follows. When the electric motor is switched on, the satellite gear cluster performs a

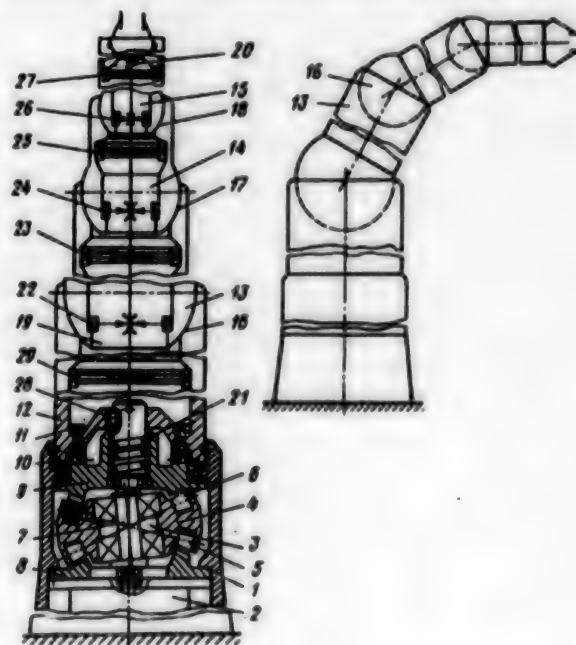


Fig. 1. Manipulator Design.



precession movement whereby the roller gear rims engage the sun gears. Furthermore, driven sun gear 9 rotates with a reduction which is determined by the number of rollers in gear rims 5 and 6 and the number of teeth in sun gears 8 and 9. When the clutch is engaged, gear 9 begins to rotate, and rotation is converted by the ball and screw transmission into reciprocation motion of the screw linked to the flexible tie. Thus, given a certain combination of controlled fixture operations, one can obtain the necessary slope angle of any moving link. For example, if controlled fixtures are engaged simultaneously, the manipulator may assume the position shown in Fig. 1. In this case, the controlled fixtures operate in different directions in each pair. For example, in order to link 13 around the center of the ball and socket joint 16, it is necessary that controlled fixture 23 pull flexible tie 19 in one direction, while controlled fixture 24—in the other direction relative to the longitudinal axis of link 13. The link rotation angle is determined as the arc tangent of the ratio of the core displacement  $\Delta S$  to the distance between the center of the ball and socket joint 16 and the longitudinal axis of the corresponding controlled fixture

$$\alpha = \frac{\Delta S_2}{\Delta a_2} = \frac{\Delta S_1}{\Delta a_1}$$

Thus, the precession reduction gear with the ball and screw transmission and centering mechanisms with the flexible tie make it possible to obtain any manipulator displacement in one plane bounded by the service area while the manipulator rotation around its axis is ensured by the precession reduction gear. This makes it possible to increase the positioning accuracy since the manipulator motions are determined by the kinematic accuracy of one precession reducer.

The use of stepping electric motors is dictated by their good controllability which eliminates the need for using a sensor manipulator element position monitoring system.

It is expedient to use Euler's angles  $\psi$ ,  $\theta$ , and  $\varphi$  which correspond to each element rotation around the axes of revolution in order to determine the manipulator arm position and orientation. Each element has a spherical contact surface (Fig. 2) and is fixed to the coordinate system of reference of the preceding i-1 element of Euler's angles  $\psi$ ,  $\theta$ ,  $\varphi$  which correspond to elementary geometrical rotations around the axes  $OZ_i$ ,  $OX_i$ , and  $OY_i$ .

The geometrical rotation around point O is characterized by the rotation angle  $\psi$ . The transformation matrix in this case assumes the form of:

$$R_\psi = \begin{bmatrix} \cos \varphi & \sin \varphi & 0 \\ \sin \varphi & \cos \varphi & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

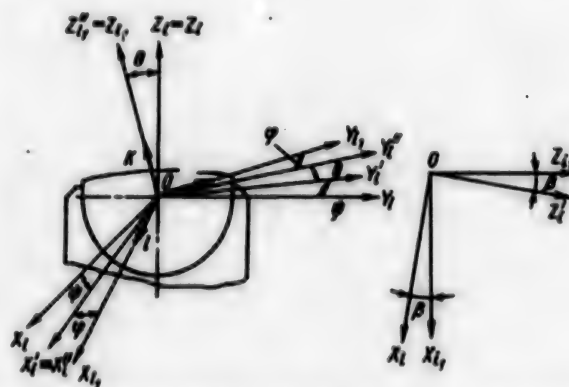


Fig. 2. Manipulator's Coordinate Frame of Reference.

This matrix is also referred to as the elementary rotation matrix. Likewise, rotation around the  $OX_i$  axis has the following rotation matrix:

$$R_\theta = \begin{bmatrix} 1 & 0 & 0 \\ 0 & \cos \theta & -\sin \theta \\ 0 & \sin \theta & \cos \theta \end{bmatrix}$$

The matrix of rotation around the  $OZ_i = OZ_{i+1}$  axis is similar to matrix (2):

$$R_\varphi = \begin{bmatrix} \cos \varphi & -\sin \varphi & 0 \\ \sin \varphi & \cos \varphi & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

The elementary matrix of rotation around the  $OY_{i+1}$  matrix is expressed as

$$R_\beta = \begin{bmatrix} \cos \beta & 0 & \sin \beta \\ 0 & 1 & 0 \\ -\sin \beta & 0 & \cos \beta \end{bmatrix}$$

Having obtained elementary rotation matrices, one can obtain the transformation matrix R, which is also referred to as the rotation matrix or transition probability matrix. For an orthogonal initial system of coordinates, we obtain the following dependence:

$$R = R_\psi R_\theta R_\varphi = \begin{bmatrix} \cos \psi \cos \varphi - \sin \psi \cos \theta \sin \varphi - \\ -\cos \psi \sin \varphi - \sin \psi \cos \theta \times \\ \times \cos \varphi \sin \psi \sin \theta \sin \varphi \times \\ \times \cos \varphi + \cos \psi \cos \theta \sin \varphi - \\ -\sin \psi \sin \varphi + \cos \psi \cos \theta \times \\ \times \cos \varphi - \cos \psi \sin \theta \\ \sin \theta \sin \varphi \quad \sin \theta \cos \varphi \quad \cos \theta \end{bmatrix}$$

Dependence (6) corresponds to elementary rotations around the  $OZ_0$ ,  $OX_1$ , and  $OZ_1$  axes. Likewise, one can determine five more combinations of Euler's angles which differ from those cited above.

Similar computations can be performed for any element  $i$  of the flexible manipulator.

Consequently, the manipulator gripper position can be analytically described and programmed at any moment in time and at any point in the service area. This significantly simplifies the manipulator control system.

For existing "elephant trunk" manipulators, the proposed design is the simplest and has the best quality indicators.

The manipulator positioning accuracy can be increased by decreasing the number of actuators and improving the element controllability.

An analytical description of the current position of any manipulator element in space ensures stored-program manipulator control.

#### Industrial Robot's Sensor Gripper

947F0041A Moscow AVTOMATIZATSIYA I SOVREMENNYE TEKHNologii in Russian No 7, Jul 93 pp 2-4

[Article by A.A. Paroy and V.I. Kuleshov; UDC 621.865.14]

[Text] In today's field of robotic systems, the outlook is good for developing the facilities and methods of adaptive control which make it possible to expand the functional capabilities of industrial robots (PR)<sup>(1)</sup>.

One of the promising robotic information facilities characterizing the parameters of the perturbing factors are sensor systems which are used for sensing computer-aided and robotized special-purpose facilities for loading and unloading explosive substances and munitions, charging systems, etc. In order to move the manipulated entities with a specific force and spatial orientation, it is necessary to measure the force vector and torque vector operating between the gripper and the gripped entity with the help of a force/torque sensor of the sensory system.

By equipping a robotic facility with a sensory system, one can plot the force control loop and utilize the principles of positional-force control which expands the functional capabilities of the robotic systems.

Traditional force measurement methods involve determining force through elastic deformation<sup>(2)</sup>. This principle underlines the operation of an overwhelming majority of facilities used for this purpose.

It is expedient to employ sensory grippers in addressing the issues of force measurement in industrial robots specialized in precision operations.

In known sensory industrial robot systems, the sensing (force measurement) function is performed by a resistance strain gauge matched with an elastic element. These devices contain the following components: a modulator-demodulator (MDM) amplifier, a direct current amplifier with a low-pass filter, a regulated power supply source, an analog-to-digital converter (ATsP), and an interface with a communication line<sup>(3)</sup>.

Yet these devices have a number of shortcomings: the complexity of structural implementation which does not make it possible to integrate the industrial robot's analog-to-digital converter and the data transmission device in the gripper and the placement of a preamplifier inside the industrial robot sensor. Data on the force in the gripper picked up from the resistance strain gauges is transmitted in the form of voltage or current to a remote analog-to-digital converter which performs the functions of converting the analog signal into a digital form and processing data on a computer.

Such devices are characterized by one significant shortcoming of analog technology—their low noise immunity and accuracy.

The gripper sensing device is executed as a fluidic instrument element located on the housing between the jaws while the output channel of this element is connected to elastic chambers through a comparison element whereby each chamber is linked to one of the fluidic elements. The chambers, in turn, are connected to the power supply through a regulator. Yet even this device has many drawbacks; a large number of pneumatic channels with local drag; and partial sensing (at the part and chamber gripping location).

The industrial robot sensory gripper (Fig. 1) contains housing 1 with jaws 2, elastic elements 3 with resistance strain gauges 4, and interface module 5 with an n-channel line.

A total of  $n$  resistance-to-time-interval converters whose inputs are connected to strain gauge resistance whereby the outputs of the resistance-to-time-interval converters are linked to an interface with an  $n$ -channel communication line is added to the gripper which contains jaws, elastic elements closely tied to the jaws, resistance strain gauges attached to elastic elements, and interfaces with the  $n$ -channel communication line.

The addition of  $n$  converters whose inputs are connected to resistors makes it possible to increase the fullness of the information content value and noise immunity in transmitting data on the value of the forces and torques developing in the gripper and structurally to integrate in the gripper the analog-to-digital converter and the data transmission device by increasing the gauge factor of the strain gauge and current coupling between data transmitting and receiving devices. It was possible to simplify the design and increase the gripper reliability due to the fact that the sensory device is executed as elastic elements with resistance strain gauges attached to them and an interface module with an  $n$ -channel communication line

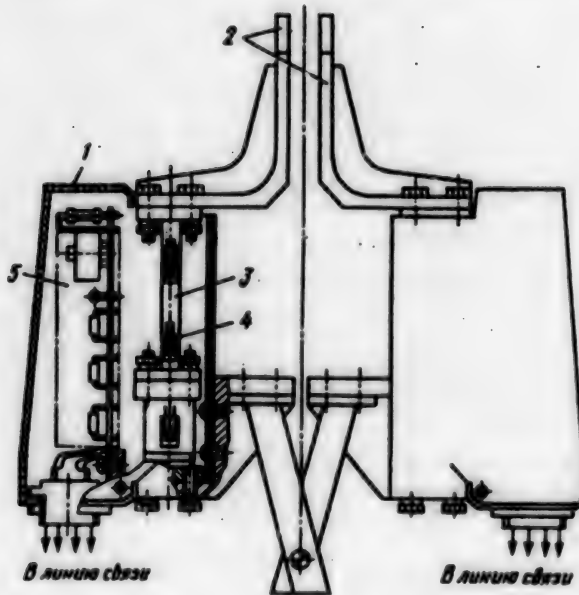


Fig. 1. Gripper

Key: On left—To the communication line; On right—To the communication line.

and  $n$  resistance-to-time-interval converters whose inputs are connected to the outputs of resistance strain gauges whereby the converter outputs are connected to the  $n$ -channel communication line of the module.

A rectangular system of coordinates which demonstrates the expansion of the vector of force and torque applied to the gripper jaw is shown in Fig. 2.

Any unit force or torque applied to the gripper may be represented as follows with respect to any point on the jaw extremity:

$$F = (F_x, F_y, F_z, M_x, M_y, M_z).$$

During the gripper operation, the external force and moment may be applied to the jaws in any direction. Elastic element 3 (see Fig. 1) is sensitive in the bending direction and is stable in all other directions, so that the resistance of each other resistance strain gauges changes insignificantly.

A block diagram of stress conversion from the force and moment components executed with the help of the gripper is shown in Fig. 3, while a circuit diagram of one of the conversion and data transmission channels from one of the force or moment components is shown in Fig. 4 where 1 is the resistance-to-time-interval converter, 2 is the resistance strain gauge, 3 is a capacitor, 4 is a univibrator, 5 is the converter input, and 6 is the interface circuit with the communication line.

The resistance strain gauge is an integral part of the resistance-to-time-interval converter. It is a primary

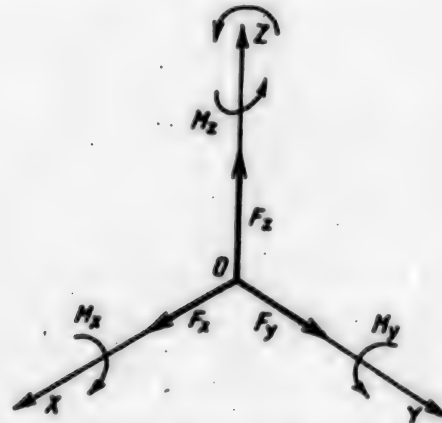


Fig. 2. Expansion of Force and Torque Vectors.

conversion element which transform a mechanical quantity into an electric signal in the form of resistance  $R_{FM}$ .

Semiconductor KDT-2B silicon resistance strain gauges which meet the specifications of AO.336235 TU and have a 220  $\Omega$  resistance and a length of 2 or 7 mm are used as primary transducers. The resistance strain gauges are glued to the measuring surface of the elastic element with a VL-931 lacquer (GOST 10402-75). Slices of the FDM-1 material with a 0.2-mm thickness (TU 16-503.084-71) are glued to the measuring spots of the elastic element. The terminal wires are glued to the slices in order to protect the resistance strain gauge from possible ruptures. The resistance strain gauges, soldering spots, and the wires are covered with the VL-931 lacquer (GOST 10462-75).

Together with resistance strain gauge 2, capacitor 3 with a capacitance of  $C$  forms a controlled RC-circuit with a time constant of  $\tau = R_{FM}C$ . The time constant value  $\tau$  determines the length of the T-pulse generated by the univibrator.



Fig. 3. Block Diagram of the Conversion Channel. On left—Primary conversion; On right—Secondary conversion.



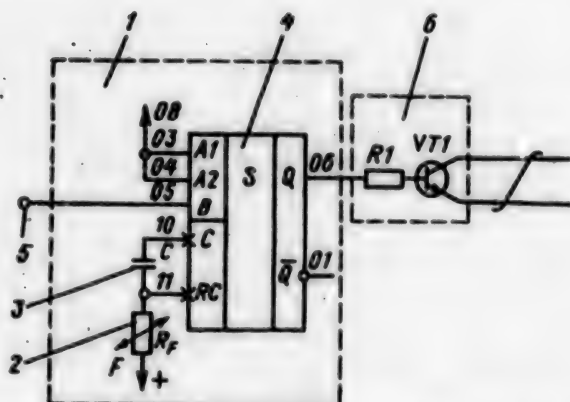


Fig. 4. Circuit Diagram of the Data Conversion and Output Channel.

The device operates in the following fashion. A force is applied to the jaws in any direction when the part is being gripped. In this case, the elastic element is deformed under the effect of this force. The stresses developing in it are picked up by resistance strain gauges whose resistance is proportionate to the elastic element tension at the place of its installation. After converting the mechanical quantity into electric in the form of resistance  $R_{FM}$ , the capacitor in the interface module of resistance strain gauge 2 converts resistance to the time constant  $\tau$  which determines the duration of the T-pulse generated by univibrator 4.

The duration of the voltage pulse at the univibrator output as well as the current pulse in the communication line contain data on the force or moment which are expressed by the following formula:

$$T = K\tau = KR_{FM}C = KC(A + BF),$$

where  $K$  is the conversion ratio of univibrator 4 and  $A$  and  $B$  are the coefficients determined by the physical parameters of resistance strain gauge 2.

The current magnitude in the communication line is important only for the data transmission noise immunity indicators and does not affect the contents of this information.

Compared to the sensors described in [2,3] which perform the force measurement function, the proposed device has the following advantages. Foil-type resistance strain gauges are used as primary transducers which greatly limits the maximum attainable output signal magnitude (the gauge factor of the foil-resistance strain

gauges is  $K = (\Delta R/R)/(\Delta l/l) = 2-3$  whereas the same figure for semiconductor devices is  $K = 100-200$ ).

The advantages of the force/torque systems described in [3] are realized provided that high-quality amplifiers are used.

Furthermore, the output voltage after primary conversion is very low, so its transmission and processing may be very complicated in the presence of electromagnetic interference. This factor often calls for placing a preamplifier inside the sensor.

Due to the use of semiconductor resistance as primary transducers in the aforementioned device, the output signal level is measured in units of volts (1-5 V) whereby it is not necessary to use amplifiers or preamplifiers.

The semiconductor resistance strain gauges' high sensitivity and the use of resistance-to-time-interval converters ensure small overall dimensions of the sensor and electronic module structure. This, in turn, makes it possible to install them directly on the gripper jaws or integrate them as a single device with the jaws.

Given a pulse data representation and transmission in a pulse form, the noise immunity indicators, compared to those of continuous representation, are much higher.

The current feedback between the data transmission and reception devices also ensures a more stable noise immunity compared to voltage feedback since based on experimental data, the current feedback even after attaining a 100-200 mA current becomes a source of noise (in this case, the output signal values reach 3-20 mA).

An increase in noise immunity is the determining factor of reliable industrial robot performance under extreme operating conditions; moreover, data transmission accuracy increases too.

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**Retrieval of Geopotential and Temperature Fields by Radio Measurement Method for Model of General Circulation of Atmosphere: Computation Method**

947N0024A Moscow DOKLADY AKADEMII NAUK in Russian Vol 333 No 5, Dec 93 pp 650-653

[Article by S. V. Sokolovskiy, Atmospheric Physics Institute, Russian Academy of Sciences, Moscow; UDC 551.501.7]

[Abstract] A computation experiment was carried out for retrieving geopotential and temperature by the Abelian inversion method using meteorological field series from the data archives of the ECHAM global model of general circulation of the atmosphere. Numerical simulation was carried out for the geopotential, temperature and humidity fields stipulated in a standard Gaussian grid with a horizontal resolution  $1.125^\circ$  and with a vertical resolution of 19 levels in the altitude range from the surface to 35 km. An algorithm for solution of this problem is given. Results are presented for the distribution of the altitude of the 200-mbar surface and the error in its retrieval, as well as the temperature distribution at this level and the error in its retrieval. It is shown that the error in retrieving potential and temperature by the Abelian inversion method is greater where the horizontal nonuniformity of meteorological fields is greater. The maximum errors are about 30 m for geopotential and about 1 K for temperature. These errors indicate the possibility of using these data in weather and climate prediction problems. Program packages make it possible to proceed to the next step: numerical simulation of assimilation of the retrieved (with errors) geopotential and temperature fields in a model of general circulation of the atmosphere for the purpose of investigating the influence of retrieval errors on the prediction of meteorological fields. Figure 1; references 9: 1 Russian, 8 Western.

**Global Climate Observing System**

947N0023 Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 6, Nov-Dec 93 pp 104-115

[Article by K. Ya. Kondratyev; UDC 528.7:629.78:551.5]

[Abstract] Conceptual aspects of the Global Climate Observing System, approved by the Eleventh Congress of the World Meteorological Organization, are analyzed. Opinions are expressed on the need for better substantiation of priorities in research on global climate change. The author quarrels with the subjects assigned to the working groups, as they do not reflect top priority problems and questions which should be addressed. The author believes that conventional and space observation facilities have not been combined in a way that achieves optimum effectiveness. It is pointed out that the list of existing satellite systems for environmental research is incomplete. Top priority studies of the atmosphere are described. Existing facilities and programs to study the atmosphere, ocean, cryosphere, and land surface are

discussed. The author charges that there has been insufficient consideration of the types of data and data series needed to study global climate change. Areas where more studies are needed, i.e., the global radiation balance, vegetation cover dynamics, interaction of atmosphere and ocean, etc., are described. References 32: 15 Russian, 17 Western.

**Reflection of Internal Wave Packets From Plane Rigid Boundary**

947N0019F Moscow IZVESTIYA AKADEMII NAUK FIZIKA ATMOSFERY I OKEANA in Russian Vol 29 No 6, Nov-Dec 93 pp 831-836

[Article by Yu. V. Kistovich and Yu. D. Chashechkin, Mechanical Problems Institute, Russian Academy of Sciences; UDC 551.466]

[Abstract] A theoretical investigation was made of two-dimensional harmonic packets of internal waves (IW) in an ideal exponentially stratified fluid. With the neglecting of the Boussinesq approximation a study was made of the reflection of monochromatic packets of internal waves from a rigid plane surface. The problem is solved in a Cartesian coordinate system with application of the phase portraits method. The phase portraits for different cases are examined in detail. Neglecting of the Boussinesq approximation results in the appearance of new effects, especially with glancing angles of incidence on the plane. If the plane is situated beneath an incident packet, in addition to an ordinary reflected packet a packet appears which transports energy in a direction opposite that of the incident packet. However, if the plane is situated beneath an incident packet a packet appears which transports energy in the same direction as the incident packet, which results in a change in the configuration of the incident packet. The envelopes of incident and reflected packets are illustrated and discussed. Figures 4; references 8: 3 Russian, 5 Western.

**Vortical Systems Behind Cylinder in Continuously Stratified Fluid**

947N0019E Moscow IZVESTIYA AKADEMII NAUK FIZIKA ATMOSFERY I OKEANA in Russian Vol 29 No 6, Nov-Dec 93 pp 821-830

[Article by Yu. D. Chashechkin and I. V. Voyeykov, Mechanical Problems Institute, Russian Academy of Sciences; UDC 532.527:551.515]

[Abstract] Detailed experimental studies were made of the fine structure of a current of stratified fluid behind a cylinder in the range of parameters:  $5 < Re = Ud/\nu < 1400$ ,  $0.001 < Fr_1 = U/Nd < 3$ ,  $120 < C = \Lambda/d < 15000$  ( $0.01 < U < 3$  cm/s,  $0.2 < N < 1$  s<sup>-1</sup>,  $0.8 < d < 7.6$  cm). In addition to internal waves, eddies and a wake current, high-gradient envelopes arising on the boundary of the density wake and in the wakes behind eddies are important structural elements of a current. The rules for

identification of eddy current elements are formulated and the following types of vortical systems are discriminated: small-scale eddies localized in a high-gradient envelope, eddies submerged in a density wake and so-called hanging eddies. The dependencies of their geometric characteristics on the current parameters are determined. A new class of instability is defined: structural (microscale) instability when a complex relief of the horizontal isopycnic surfaces is observed against a background of a smooth velocity distribution. Fourteen characteristic types of structures are discriminated and a map of current systems is plotted. It is shown that on the  $(\lg Re, \lg Fr_1)$  plane the boundaries between systems are segments of straight lines. Figures 5; references 13: 8 Russian, 5 Western.

### Three-Dimensional Problem of Flow of Multilayer Fluid of Finite and Infinite Depth Around Source

947N0019D Moscow IZVESTIYA AKADEMII NAUK FIZIKA ATMOSFERY I OKEANA in Russian Vol 29 No 6, Nov-Dec 93 pp 771-779

[Article by K. A. Bezhanov and A. M. Ter-Krikorov, Moscow Physical Technical Institute; UDC 532.593:551.466.4]

[Abstract] Disturbances introduced into a multilayer flow of an ideal incompressible heavy fluid by a point source are examined. The fluid has a finite number of layers and an arbitrary velocity and density distribution in each layer, but in the case of a fluid of finite depth it is assumed that the lower infinitely deep layer has a constant velocity and density. The field of disturbances is represented in the form of a double integral of the Green's function of the auxiliary spectral problem for an ordinary differential equation dependent on two complex parameters. In the case of a fluid of finite depth the properties of the discrete spectrum of this problem make it possible to represent wave and nonwave disturbances in the form of a series of single integrals. In the case of a fluid of infinite depth the properties of the discrete and continuous spectra of the auxiliary spectral problem make it possible, by virtue of the smallness of the stratification parameter, to represent the field of disturbances in the form of wave disturbances having the form of an infinite sum of the single integrals and nonwave disturbances in the form of a double integral. The special case of two layers of a constant density with an infinitely deep lower layer is investigated. References 18: 17 Russian, 1 Western.

### Energy Losses in Radiation of Gravity Waves Accompanying Fast Movements of Sources

947N0019C Moscow IZVESTIYA AKADEMII NAUK FIZIKA ATMOSFERY I OKEANA in Russian Vol 29 No 6, Nov-Dec 93 pp 739-743

[Article by V. A. Gorodtsov, Mechanical Problems Institute, Russian Academy of Sciences; UDC 551.466.8]

[Abstract] The integral characteristics of the field of internal waves generated by rapidly moving bodies in fluids with different stratifications can be evaluated without full solution of the problems involved in flow around bodies. The following aspects of the problem are examined: wave losses for uniformly horizontally moving bodies; waves at surface of homogeneous fluid and at interface of two fluids; waves in homogeneously stratified unbounded fluid; internal waves in stratified waveguide with horizontal boundaries. The high-velocity asymptotic form of wave resistance is of the power-law type with respect to velocity (resistance is inversely proportional to the square of the Froude number), other than for the case of movement in the maximum stratification zone and at a great distance from it in a deep fluid. In the first case (such as during movement of a fluid along the surface, through the density jump and in a uniformly stratified unbounded fluid) a logarithmic dependence on the Froude number is added. In the latter case it becomes exponential. The method used also is applicable for other wave types. With respect to the distribution of radiated energy by different modes, an analysis indicates a slowness of dropoff of the contributions with an increase in the mode number in situations close to homogeneous stratification. With a sufficiently strong localization of stratification only the lowest modes can be significantly generated. References 5: 3 Russian, 2 Western.

### Influence of Internal Waves on Hydrodynamic Characteristics of Submerged Body

947N0019B Moscow IZVESTIYA AKADEMII NAUK FIZIKA ATMOSFERY I OKEANA in Russian Vol 29 No 6, Nov-Dec 93 pp 732-738

[Article by I. V. Sturova, Hydrodynamics Institute imeni M. A. Lavrentyev, Siberian Department, Russian Academy of Sciences; UDC 532.59:551.466.8]

[Abstract] The results of numerical solution by the hybrid finite elements method (FEM) of the linear stationary problem of uniform flow around a horizontal cylinder situated beneath the pycnocline are presented. The FEM can be used for bodies of a complex configuration or system of bodies, but also is applicable to the case of a stratified fluid in which density change occurs only at horizons situated above a submerged body. In all the cases considered here the submerged body is positioned completely in the lower layer with an infinite depth. Two- and three-layer stratification models corresponding to sharp and smooth pycnoclines are examined. The flow direction is perpendicular to the cylinder axis. A sharply expressed pycnocline is simulated by a two-layer fluid; a smooth pycnocline is simulated by a three-layer fluid with a linearly stratified middle layer and homogeneous upper and lower layers. It is demonstrated in the example of an elliptical cylinder that stratification exerts a substantial influence on all the hydrodynamic characteristics (wave resistance, lift and momentum) in definite velocity ranges. A comparison



with an approximate analytic solution suitable for a deeply submerged body is given. Figures 6; references 14: 9 Russian, 5 Western.

#### **Anomalous Frequency Dispersion of Internal Waves in Ocean**

947N0019A Moscow *IZVESTIYA AKADEMII NAUK FIZIKA ATMOSFERY I OKEANA* in Russian Vol 29 No 6, Nov-Dec 93 pp 711-718

[Article by S. F. Dotsenko, Marine Hydrophysics Institute, Ukrainian Academy of Sciences; UDC 551.466.81]

[Abstract] The existence of vertically spaced local maxima of the Brunt-Vaisala frequency  $N(z)$ , playing the role of waveguides for IW, usually leads to the appearance of anomalous frequency dispersions (AFD). This problem is examined using data for a region of the Atlantic to the northwest of Great Britain where the upper waveguide corresponds to the seasonal pycnocline and the lower waveguide to the principal pycnocline. The existence of several pycnoclines and extended layers with quasiconstant  $N(z)$  values is characteristic of the North Atlantic, Indian Ocean and Black Sea. An anomalous frequency dispersion of IW is expressed in the appearance of local extrema of group velocities in the range of relatively large wave numbers. This is attributable to the characteristics of vertical density stratification in the ocean. The characteristics of such dispersion in an ocean with several pycnoclines are examined. Its influence on the vertical structure, evolution and generation of wave fields is analyzed. Manifestations of the anomalous frequency dispersion of internal waves in real wave processes are discussed. Among the aspects of the problem examined are: energy exchange between waveguides, BKW approximation for internal waves in ocean with two pycnoclines; cluster character of dispersion; Airy wave packets; IW generation. Figures 6; references 23: 21 Russian, 2 Western.

#### **Features of Ferromanganese Ore Deposition Near Rift Zone of Mid-Atlantic Ridge**

947N0025A Moscow *DOKLADY AKADEMII NAUK* in Russian Vol 333 No 6, Dec 93 pp 738-741

[Article by Ye. S. Bazilevskaya and S. G. Skolotiyev, Geology Institute, Russian Academy of Sciences, Moscow; UDC 551.35]

[Abstract] Hydrothermal activity and manifestations of ferromanganese ore deposition were studied in the region of the juncture of the southern segment of the Mid-Atlantic Ridge with a fault zone at 15°20'N (Cape Verde fault). A diagram of the work region is given showing two intersections of the rift zone of the Mid-Atlantic Ridge by the Akademik Nikolay Strakhov research ship. Along these intersections samples were taken which revealed significant changes in Fe-Mn encrustations. This zone is characterized by the presence of traces of hydrothermal activity, but it varies greatly from place to place. It is clear that anomalies in the composition of Fe-Mn deposits can be used in detecting endogenous activity on the ocean floor, but the problem of the reasons for these anomalies is more complex. In discussing this problem it is noted that in contrast to iron, much of which is removed from the geochemical cycle due to the formation of insoluble sulfides, the cycling of Mn in the ocean is much different. It does not form insoluble minerals but passes into solution and reenters sea water. Most of the Mn bound in Fe-Mn deposits was regenerated from ancient sedimentary deposits. This is attributable to the fact that any tectonomagmatic events on the ocean floor, from local manifestations of volcanism, spreading and subduction to global changes in the position of the continents on the planet, are always accompanied by the appearance of reduction conditions favoring the migration of earlier deposited manganese. The process of oceanic Mn accumulation is unique; it creates a background against which not only all events on the ocean floor occur, but also against which the maintenance of chemical equilibrium in sea water is dependent. The role of oceanic Fe-Mn deposits in maintenance of the ecological purity of the planet is comparable to the role of forests on the land. A study of the composition of the Fe-Mn deposits not only makes it possible to clarify problems involved in ore formation, but also provides additional possibilities for characterizing tectonomagmatic conditions in active regions on the ocean floor. Figure 1; references 8: 6 Russian, 2 Western.

## AGRICULTURAL SCIENCE

### In an Interfarm Biolaboratory

947C0043E Moscow ZASHCHITA RASTENIY  
in Russian No 2, Feb 93 p 16

[Article by V. P. Borovaya, director, Biota Scientific-Production Association]

[Text] An interfarm biological laboratory was organized in 1990 in Leningradskiy Rayon, Krasnodar Kray at the Leningradskoye APO [Agricultural Production Association?]. Besides producing biological agents, its has been ordered to reveal the most dangerous pests and diseases of agricultural crops, to draw maps of their occurrence at farms, and to develop the methods of effective use of different microbiological preparations and monitoring the quality of biological agents delivered to the rayon's farms. The Northern Caucasian Scientific Research Institute of Phytopathology provided technical and methodological assistance to the laboratory in all of these years.

In the stage of initial development, our main goal was to establish a collective of like-minded individuals capable of organizing production of biological agents in the shortest time possible, and to unite farm agronomists around the idea of ecologically compatible plant protection. We believe we were able to solve this problem successfully. The biolaboratory, which has become part of the Biota Scientific-Production Association, currently employs 12 persons, including Doctor of Biological Sciences T. S. Ivanova (a nematologist), Candidate of Biological Sciences A. P. Luda (a microbiologist), five highly qualified specialists with a higher biological and agricultural education, and four laboratory technicians.

The laboratory has equipment making it possible to produce microbiological preparations such as rizoplan, bitoksibatsillin, lepidotsid, baktovit, preparation-2 and trichodermin, and preparations based on predatory nematodes.

The first lots of bacterial and fungal preparations were produced in May 1991 according to procedures introduced at the SK NIIF [not further identified]. In addition the laboratory's associates underwent apprenticeship at the All-Union Scientific Research Institute of Applied Microbiology (Obolensk), where they mastered the methods of producing and using several microbiological preparations. A highly active strain of *Trichoderma* was revealed independently. It is now being used in greenhouses of Leningradskiy Rayon to control root rot. The laboratory is also developing preparative forms of biological resources based on entomopathogenic nematodes that are highly effective (70-95 percent) against wireworms and potato moths. A total of 7,200 liters of biological preparations were produced in 9 months of 1992.

During the time that the scientific and practical directions of the laboratory's work were forming and it was

financed out of the budget of the Leningradskoye APO, its activity moved along quite briskly. But the situation changed after transition to full cost accounting. Difficulties typical of not just our enterprise alone came into being. An acute need arose for increasing production volume and fitting out the laboratory with highly productive equipment (primarily fermenters of different capacities), for erecting a separate production building, a boiler plant and so on, and for solving a number of public health problems. All of this requires considerable resources! Realizing the concept of low-volume microbiological production will doubtlessly require investors.

The problems of supplying laboratories with strains of industrial microorganisms satisfying all of the requirements of modern production, and of organizing advanced training courses for laboratory associates, have not been solved.

There is a problem in keeping personnel employed year-round. Everyone is busy in spring and summer, but in fall and winter the few greenhouse complexes are unable to keep our work profitable. We are looking for things for the people to do—perhaps producing yeast for food industry, feed additives, silage leaven for animal husbandry, and biologically produced humus.

We would be interested in knowing how other collectives are solving these problems.

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### Industrial Production of Fungal Preparations

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in Russian No 2, Feb 93 pp 14-16

[Article by G. A. Gorokhov, division director, Giproniselprom, and G. T. Fatuyeva, microbiologist and process engineer, Biozar TOO]

[Text] Interest in ecological clean microbiological preparations that are relatively safe to use has grown in recent years both in our country and abroad. According to estimates of foreign specialists the market for biopreparations used in plant protection has increased annually by 4-5 percent since 1984. The outlays of the leading chemical companies of the USA, Great Britain, the FRG, Denmark, the Netherlands and Brazil on developing the procedures of acquiring biopreparations are from 2.5 to 12.5 percent of the total expenses of the companies. What is significant is that the outlays on developing biopesticides are 3-5 times lower than on research and development of chemical preparations. We can also add to this the relatively less expensive and faster registration of biopreparations (\$500,000 and a testing period of up to 3 years) as compared to chemical ones (from \$10 million to \$20 million and a testing time of up to 7 years or more).

Besides by ecological problems, development of this alternative method of protection is stimulated in Russia and CIS countries by the shortage of even chemical pesticides in the market.

However, analysis of the situation that has established itself in the domestic biopreparation market revealed a totally unfavorable state of affairs. Development of modern production processes for microbiological plant protection resources, creation of new biopreparations, improvement of existing ones, and the problems of their mass production and use for integrated protection of agricultural crops remain behind the needs of practice. Much of the research ends right after the producer strains are studied, or in the best case it gets as far as developing the laboratory procedures of their acquisition. For these and a number of other reasons only four out of all of the biopreparations recommended for use are presently being produced by industry.

Current high-volume production of microbiological plant protection resources, which is based on subsurface procedures, is not adapted to the needs of agriculture because of the absence of feedback between consumers and manufacturing plants. The possibility of transition to the production of new biopreparations, especially those requiring changes in the production process, is limited.

The idea of organizing regional low-volume operations producing microbiological preparations is fully justified not only because this makes it possible to create flexible all-purpose lines capable of quickly saturating the market with new biopreparations, but also from the standpoint of reducing the ecological load upon the environment and bringing production into the direct proximity of the consumer. At this moment the list of microbiological plant protection resources currently produced by industry is limited to bacterial preparations with a spectrum of action that does not encompass a significant part of the most dangerous diseases and pests. Despite the high demand for fungal preparations, their industrial production has still not been organized. Difficulties arising in organizing their industrial production are rooted in the particular features of the production process, which includes a stage of solid-phase or surface cultivation.

In distinction from bacterial preparations, fungal preparations may be produced both by subsurface and by subsurface-solid phase procedures. In this case the latter is preferred because it simulates the natural means of existence and reproduction of fungi in nature. But it is precisely for the solid-phase stage that equipment is still unavailable. Laboratory models of such systems are unsatisfactory when the process is scaled up. These are engineering problems, and to biologists they are an insurmountable barrier to designing the equipment.

From our point of view, when we organize production we need to shift the accent in the direction of solving the engineering problems of providing industrial facilities to

support the stage of solid-phase cultivation. This approach to the problem is all the more necessary because the solid-phase stage exists in production processes found in contiguous fields of biotechnology (protein enrichment of feed, enzyme production etc.) that are experiencing similar difficulties in technical support.

An exchange of opinions among specialists on the biotechnology of microbiological plant protection resources at the latest meeting of the bureau of the plant protection division of the Russian Academy of Agricultural Sciences (29 September 1992) confirmed that progress in commercializing fungal resources has in fact come to a standstill because of the absence of facilities for industrial production. Scientific research on creating, testing and producing these preparations requires creation of its own aseptic, automated, ecologically clean industrial-scale testing stand combining both directions of acquisition of fungal preparations—subsurface and solid-phase.

The first stage of organizing such a stand (a pilot facility), and in the future a network of regional small enterprises on its basis, requires that we determine the volume of fungal biopreparations actually needed by agriculture. This will make it possible to substantiate the terms "regional" and "low-volume" production not only qualitatively but also quantitatively, and to determine the productivity of the pilot facility on this basis.

From our point of view the problem of providing fungal preparations should be considered initially in relation to sheltered ground. The range of use of fungal plant protection resources in greenhouses is considerable, and it will grow in the future. In order to determine the possible market we need to consider the actual distribution of greenhouse complexes, their area, the transportation systems and the possible contributions by farms to production development, and strive to maintain an antimonopoly policy and ecological safety of land adjacent to the enterprise.

The CIS countries presently have around 5,000 ha under glass and 11,000 ha under film, with around 6,600 of these hectares being in nursery greenhouses (in Russia there are around 2,000 ha of glass greenhouses in 137 sovkhoses and 11 kolkhoses). In this case the concentration of greenhouse area is extremely nonuniform in different regions of CIS countries: For example over 250 ha are scattered among farms in the form of greenhouses with an area less than 3 ha, while on the other hand around 400 ha are concentrated in the Moscow vicinity, and in Stavropol Kray, the single Yuzhniy Sovkhoz has an area of 144 ha.

If we orient ourselves on production of biopreparations already permitted for use (trichodermin, boverin and verticillin), and consider the accumulated experience of their use and the actual distribution of sheltered ground area, the following productivity of an industrial-scale stand would be the most suitable: for trichodermin preparation—66,000 kg, for boverin concentrate—4,000 kg, for verticillin concentrate—2,400 kg per year.



These figures make it possible to tentatively estimate the quantity of regional low-volume production operations. In Moscow oblast for example, which has a sheltered ground area of around 400 ha, two facilities producing trichodermin, one facility producing boverin and three facilities producing verticillin need to be established. Given the designated productivity, a minimum of three facilities producing different preparations will have to be established in each of the oblasts possessing the largest area of sheltered ground. On the whole, the tentative number of facilities for vegetable greenhouses, including film and nursery, will be 157.

However, it is impossible to consider series production of facilities of this type right away. There are a number of causes retarding organization of production: The results of fundamental research are insufficient to permit establishment of the initial requirements on equipment for the production processes; the list of equipment available for solid-phase cultivation is limited; there are few enterprises capable of producing nonstandard equipment; the procedure of using biopreparations has not been perfected. Therefore we need to gather together all of our knowledge and create at least one "pioneer" pilot facility. This will not only concentrate the results of scientific research but also reveal those design offices and plants that will be able to continue this work. Moreover in addition to engaging in scientific activity associated with introducing new production processes, a scientific and technical center established on the basis of this first facility will also involve itself in producing and distributing biopreparations in the season of their use, this bringing in financial resources to partially support itself.

Work on new equipment foresees evaluating the shortcomings and merits of developments of previous years. Enzyme industry studied the issue of creating instruments for the solid-phase cultivation stage seriously and deeply back in the 1960s-1970s using, as its initial models, highly productive equipment created in the chemical sector of industry. In the final stages of the work it gradually became overwhelmed by a large quantity of diverse attachments, mechanisms, devices and life-support systems, which had a negative effect on acquisition of high concentrations of the target product. This forced them to abandon the solid-phase method of cultivation at the production scale and switch to the subsurface method, which permits more effective control of the production process and use of previously created standard equipment. It is now recognized that this approach failed to justify itself in application to fungal preparations, and a return to the solid-phase method of their acquisition is occurring abroad. Consequently we need to offer the corresponding equipment to practical workers in the new stage of technical development.

However, while the problems of organizing subsurface production have been studied sufficiently well, it is difficult to trust the results of developing industrial procedures of solid-phase cultivation because not

enough research has been carried out on heat and mass exchange in the fermentation process. In the meantime it is precisely the hydrodynamic and the heat and mass exchange processes that do not yield to upscaling by extrapolation, and require modeling in real conditions. And this is something a pilot facility would be able to do.

Analysis of existing technical concepts and of the priority directions of designing equipment permits us to adopt, as our basis, a continuous production process based on production lines built according to the modular unit principle. According to this principle the structure of a line is formed out of separate modules of particular output dependent upon the output of the facility as a whole. The modules are interlinked on the basis of material flows. This principle makes it possible to reduce time outlays, resetting the equipment is simplified, and the preconditions are created for raising the level of automation, unification and standardization of particular modules, units and the facility as a whole.

We proposed a general plan for a pilot facility producing fungal pesticides on a modular unit basis. This single facility brings together a number of technical concepts qualifying as inventions, beginning with electrically driven containerized pipeline transport, electrophysical methods of sterilizing the material flows and the airtight circuit, and use of an aerosol working medium in the air conditioning system to support heat and mass exchange during fermentation, and ending with electrolytic liquid waste treatment.

Research ordered by the Giproniselprom [not further identified] (Orel) was conducted by the VNIIBiotekhnologiya [All-Union Scientific Research Institute of Biotechnology] (Moscow) to create the above-described pilot facility for subsurface-solid phase cultivation of fungal pesticides. The initial requirements on developing production lines were prepared and technical concepts were developed on the basis of these requirements as a result.

The complex of scientific research and experimental design work carried out by us (Giproniselprom, VNIIBiotekhnologiya and other institutes) in 1988-1990 and the practical experience of the Biozar Enterprise, established at the Belaya Dacha Sovkhoz, demonstrated the solvency of the decisions.

However, unique experimental research and implementation of these decisions were halted because of the absence of financing. It would be desirable to continue the work, before the researchers move on to other forms of activity. Steps must be taken to finish working up the program as quickly as possible, and to coordinate its individual sections associated with development of different directions of biological protection.

Creation of complex biological production equipment will require the joint efforts of specialists in different sectors of science and industry. The daily grind of organizing research, financing and planning, and bringing the results together into a single system must go

on. Such work cannot be done in breaks between principal activities; it must be carried out by a collective of like-minded individuals, since otherwise it would be difficult to count on the anticipated effect of development as a whole. But under our system the situation is promoting not consolidation but disintegration of creative collectives, and namely because of the absence of financing.

State programs on biotechnology have been adopted in all developed countries, chiefly because the practice of financing large problems by private companies has not justified itself. Private clients are interested, after all, in a quick return from realization of a project. And this is not always possible, especially in the case of long-term programs. Greenhouse complexes in Russia and other CIS countries, which are potential orderers of biological resources, are unable to pay for large scientific developments in the situation as it is today. The one thing they can do is fund construction of facilities, and even so, not always.

The exploratory nature of future scientific research and experimental design work presupposes the need for state financing.

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#### **Agricultural Production Ministry Program to Manufacture Small-Scale Fermenters**

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in Russian No 2, Feb 93 pp 12-14

[Interview with Vladimir Petrovich Filatov, chief, biological methods subdivision, Plant Protection Administration, Russian Ministry of Agricultural Production, by T. N. Fomenko; place and date of interview not given: "The First Facilities Will Begin Working as Early as in March"]

[Text] The problem of organizing low-volume regional operations producing microbiological preparations within the state agricultural service is now being broadly discussed among specialists. We asked V. P. Filatov, chief of the biological methods subdivision of the Russian Agricultural Production Ministry's Plant Protection Administration, to describe the means by which this administration plans to solve the problem.

[Fomenko] Vladimir Petrovich, what compelled the Plant Protection Administration to address the idea of organizing low-volume regional production operations?

[Filatov] Twenty-five biological agents can now be used to protect agricultural crops in greenhouses—12 useful insects and 12-15 biopreparations. New, highly effective developments exist which require extensive testing under production conditions. Possessing such a huge potential, we could significantly increase the role played by the biological method on open and especially on sheltered ground. However, our high-volume "giants"—the plants of microbiological industry—are extremely

sluggish. Their production continues to revolve around a few bacterial preparations coming in imperfect preparative forms. The plants never did get into producing fungal preparations. Nor are they willing to produce small, so-called low-volume lots—that would be unprofitable. To make matters worse, the plants supply their products to agriculture in the third and fourth quarters, forcing the farms to store biopreparations locally until the following summer. All of this brings out uneasiness and a mistrust of the manufacturer, the preparations and the biological method as a whole.

Considering the many years of practical work with the plants, and their slowness in making use of scientific developments, we were forced to create biofactories and biolaboratories within the plant protection system, which began producing a broader assortment of biological resources in direct proximity to the consumer. Life has confirmed the correctness of the selected path. All that has been done to introduce the biological method in recent years is a credit to it. However, time is marching on, and laboratory procedures remain at a primitive level—jars, rockers, cans, etc. As an example, production of baktorodentsid requires "babying" it manually 10-15 times. The quality of the products is unstable. Nor are the biolaboratories always able to produce the needed volume, especially if the preparation is new and effective, and if the demand for it is snowballing.

There is but one solution—we need to have our own low-volume production operations, ones established on the basis of equipment similar to that used in industry.

[Fomenko] What has been done already in this direction?

[Filatov] The Russian Ministry of Agricultural Production has allocated the money, and it has found a certain defense industry enterprise to manufacture the needed equipment. We went there in August 1992 together with specialists—process engineers and microbiologists—and contracted for the creation of five facilities producing bacterial and fungal preparations in the form of pastes rather than dry powders. First of all, pastes have a shelf life of up to 6 months, which is fully sufficient considering the mobility of production and its proximity to the client. Second, this form is applied more easily—it doesn't create dust, and it doesn't clog sprayers. Third, paste preparations will be 40 percent cheaper than dry ones. Moreover their effectiveness is usually 10-15 percent higher.

[Fomenko] What does the set of equipment possessed by such facilities include?

[Filatov] A steam generator, a compressor, coarse and fine cleaning filters, 10, 100 and 1,000 liter fermenters, a separator and a filtering unit to concentrate the product.

[Fomenko] What preparations have you decided to produce in the first stage?

[Filatov] We have an extremely great need for aktinin to control the spider mite, ampelomitsin, boverin of various strains, trichodermin of various strains, nematofagin, mikoafidin, piromorfin, fitolavin and rizoplan. The last preparation, by the way, is needed in large volumes, and one of our facilities will be able to produce up to 700 kg of rizoplan daily. We will also produce pentofag and bakterodentsid. We plan to introduce the procedures of producing lepidotsid, bitoksibatsillin, gomelin and dendrobatsillin in paste form.

[Fomenko] When will these facilities be ready?

[Filatov] The manufacturing plant is to turn them over fully ready for use in March 1993. It will provide guaranteed repairs and service for a year.

[Fomenko] Where are they to be located?

[Filatov] In the most "needy" places: in the health resort zone of the city of Bolshiye Sochi, and in Krasnodar, Voronezh, Kirov and Yoshkar-Ola, to perfect the procedures and debug the equipment.

[Fomenko] Will specially adapted premises and buildings be needed for them?

[Filatov] The set of equipment can be located in an area of 30 m<sup>2</sup>, and its height will not exceed 2 meters. Suitable space will probably be found at the plant protection stations. There is only one important condition that must be observed: A supply of up to 100 kW of electric power.

[Fomenko] Who will work at these plants, where are you going to get the specialists?

[Filatov] There are microbiologists in our service that could take on this job. Moreover we have reached agreement with workers of the Omutninsk Plant to organize courses for our specialists in which they could learn the procedures of working with the new facilities.

[Fomenko] How will the production volume and assortment of preparations be determined?

[Filatov] The low-volume production operations need to seek customers themselves. Anyway, in this stage they won't need to seek them—they are already known. First, we have greenhouse complexes, kolkhozes, sovkhozes, commercial farms, and storehouses in which products are processed before storage. Also, we are doing little to satisfy the demand of clients in the private sector, the army of which is growing, and which has always been and will always be interested in ecologically clean products and safe plant protection resources. That is, the range of our customers is very wide.

Unfortunately we are doing little to provide publicity and information on biopreparations. Agronomists need to know, for example, that the Colorado beetle could be fought not only with the preparation detsis, but also bitoksibatsillin, and the effective preparation detsimid; there are plans for carrying out field tests with the new

preparation Colorado. If we sit down and think about it, we already have five effective microbiological resources for controlling these pests that are in no way inferior to chemical ones. Once they learn about them, the demand will doubtlessly grow.

[Fomenko] Vladimir Petrovich, considering the known demand for biopreparations, how do you feel, how many facilities will be needed, in an oblast for example?

[Filatov] A single facility wouldn't of course solve the problem in some southern oblasts, two or three would be needed. Moreover in our planning work we foresaw the possibility of increasing their productivity by 2-3 times. This "reserve" is present in all of the machine units—in those delivering steam and air, and in filtering units. Just add another fermenter, and the possibilities will widen significantly.

[Fomenko] The first five facilities will be practically given away to Krasnodar, Sochi, Kirov and other cities. What if other oblasts would want to have the same kind of equipment? Will they have to buy it?

[Filatov] Yes, they will have to buy it.

[Fomenko] How much does one such set cost?

[Filatov] It's no secret: We signed a contract with manufacturing plant for five facilities for a total of 32 million rubles.

[Fomenko] Will clients have to apply directly to the plant, or would it be more advantageous to work through the Plant Protection Administration?

[Filatov] I wouldn't want this to be done directly through the plant. Here is why. It would of course be profitable for the plant, because it is looking for work. But we would like to perfect the production operation, to teach people, to check out everything and achieve maximum reliability ourselves for the time being, within the plant protection service, with our own specialists. After all, the equipment has to work without interruption for more than just a single year. The plant is not going to become involved in training personnel and tailoring the instruments to each client. After we get all of the bugs out, let potential clients visit us, see the facilities in operation, and they can decide for themselves whether they want to acquire the equipment.

[Fomenko] If everything goes according to plan, will high-volume microbiological production operations become unnecessary?

[Filatov] No. Plants of microbiological industry will continue to produce large lots of preparations—over 500 tonnes. They won't lose any clients if the quality of their products is high and if they are convenient to use. All the more so because microbiological resources are now becoming competitive with chemical ones both in price and in effectiveness, while in terms of ecological safety they are far superior.



[Fomenko] What is your attitude toward the numerous cooperatives and small enterprises outside the plant protection service that have now begun producing microbiological preparations?

[Filatov] It is fully positive, though at the same time cautious. Because production and use of biopreparations by nonspecialists who violate the procedures may result in woeful consequences. The Russian Ministry of Agricultural Production and the Ministry of Health have even prepared a special document calling for the prohibition of unregulated production of fungal and bacterial resources. Please understand me correctly: We do not fear competition with any other producers. The more preparations that are produced, the better. The only thing is that the producer must have all of the necessary documents, the technical conditions and regulations must be observed, and emblems of quality and guarantees must be present. Then there wouldn't be any problems.

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#### Regional Production of Pesticides Proposed

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in Russian No 2, Feb 93 p 11-12

[Article by Academician-Secretary V. A. Zakharenko, plant protection division, RASKhN: "Under Discussion in the Russian Academy"]

[Text] In light of the abrupt decline in industrial production of pesticides and microbiological plant protection resources, the plant protection division of the RASKhN [Russian Academy of Agricultural Sciences] raised the question "On the Status, Prospects for Development and Organization of Low-Volume Regional Production of Microbiological Plant Protection Resources" before the bureau and the presidium of the RASKhN. It was discussed thoroughly on 28 September and 15 October 1992 respectively.

Organizing regional production of microbiological resources for Russia is important in connection with the departure of the Progress Plant (Kazakhstan), the Zaporozhye and Novgorod-Volyn (Ukraine) and Ungeny (Moldova) plants, and some scientific research institutions—the VNIIBMZR [All-Union Scientific Research Institute for the Biological Method of Plant Protection] (Moldova), and the VNIIGINTOKS [All-Union Scientific Research Institute of Hygiene and Toxins] and the Biotekhnika VNIITs [All-Union Scientific Research Institute of Ecology Center] (Ukraine)—to other sovereign states, resulting in a worsening of scientific support and deliveries of biopreparations. Given an annual demand of 35,000-40,000 tonnes, Russian agriculture receives 10,000 tonnes from biological plants and laboratories and uses biopreparations over an area 5.5-6 million ha, corrected to a single application per ha—that is, only around 5 percent of the area of plowland and perennial plantations.

Under the conditions of a market economy, in the absence of proper consideration of natural and economic conditions and the health of plants on agricultural land, the monopoly on industrial production of biopreparations has been found to be insufficiently effective. Difficulties in determining marketing strategy and studying the demand for biopreparations resulted in the fact that even with extremely low production volumes, unsold biopreparations that are losing their potency have accumulated at warehouses of Russia's sole plant in Berd, and at warehouses of the Selkhozkhimiya Association.

The noted shortcomings of monopolistic, large-scale industrial production could be surmounted by combining it with more-flexible regional production adapted to local conditions and producing in low volumes. The concept of such production was developed by scientists of the Russian Agricultural Academy, the Ministry of Agricultural Production, the Russian Ministry of Health and specialists of the GKNT [State Committee for Science and Technology]. The planning and establishment of low-volume production on standard equipment using standard procedures in industrial-type biological enterprises is proposed by this concept.

The scientific and organizational groundwork for reaching these objective has been laid in Russia.

1. Scientific institutions working in the field of plant protection have developed new, promising preparations corresponding to or exceeding the best foreign analogues in their effectiveness, and the technical conditions of their production and use were developed on the basis of the results of research carried out within the framework of the "Biopesticide" project of the GNTP [State Scientific-Technical Program?] "Agricultural Production Processes of the Future," and within the framework of fundamental and priority applied programs. For example jointly with other organizations the VIZR developed mikoafidin T, entoks, afidol, verticillin M and aleysid, which are highly effective in protecting plants from aphids, the spider mite and whiteflies; alerin B and C for protection against agents of root rot, blight, fusarial head blight and powdery mildew. These preparations have no analogues in world plant protection practice.

2. Original procedures have been developed for making fungal preparations—boverin, verticillin, trichodermin and rizoplan, bacterial preparations based on *Bacillus turingiensis* baktorodentsid, and viral preparations. Production procedures have been introduced in biological production laboratories. In particular, trichodermin is being produced by 90 laboratories, verticillin by 35, and boverin by 5 with a production volume of up to 5 tonnes. However, the absence of equipment is reducing the quality of the procedures for producing the biopreparations.

3. Experimental industrial production of practically all known means of obtaining biopreparations (subsurface, surface-subsurface, surface) on standard equipment at

pilot plants using progressive procedures is being perfected. Production of metabolite preparations is being organized at the Etoks Experimental Production Enterprise (St. Petersburg), production of the biopreparations alerin B and alerin C obtained by a subsurface procedure is being organized at the Shchelkovo Biological Works (Moscow Oblast), and production of preparations obtained by a subsurface-surface procedure is being organized at an experimental production operation of the VNIIF [All-Union Scientific Research Institute of Phytopathology] (Moscow Oblast).

Production of viral and microsporidial preparations (out of parasitic protozoans) is to begin in 1993 at experimental plants of the SK NIIF [not further identified] and the VNIIF; production of preparations consisting of entomopathogenic nematodes and their symbiotic bacteria (nemobakt) is to begin at the Kolpino EPP [not further identified] (Leningrad Oblast).

Pilot facilities were introduced in 1992 at the Kolpino EPP to perfect production of mikoafidin and entoks out of entomopathogenic fungi for use against aphids; of alelysid and verticillin against the orange whitefly at the Leto PNO [not further identified] (Leningrad Oblast); of the viral preparation virin-GYaP against the codling moth at the SK NIIF; of trichodermin in the city of Kirshi (Leningrad Oblast).

Experimental industrial production of the indicated preparations at pilot facilities is the first phase of establishing standard low-volume production of microbiological plant protection resources.

4. Seventy-nine biolaboratories, 13 biofactories, 41 oblast plant protection station shops, 159 greenhouse laboratories, 56 farm and interfarm laboratories, 13 small enterprises and 10 cooperatives are functioning within the Ministry of Agricultural Production. The Russian Ministry of Agricultural Production has begun the work of providing modern equipment for low-volume production of biopreparations to biolaboratories and biofactories. In 1992 the Sochi, Voronezh, Krasnodar, Mary and Kirov biolaboratories were equipped with fermenters with capacities of up to 1 m<sup>3</sup>, separators, and other equipment for the production of liquid fungal and bacterial preparations. This work would have been more effective, had there been closer contact between specialists and scientists of the Russian Ministry of Agricultural Production and the Russian Agricultural Academy, and had they carried out coordinated programs.

The presidium of the Russian Agricultural Academy has determined the direction of scientific and technical support to organizing regional low-volume production of microbiological plant protection resources. Reaching scientific objectives in stages was proposed within the framework of the GNTF "Agricultural Production Processes of the Future" and the "Plant Protection" sector program of fundamental research. And namely:

- conducting marketing research to substantiate the demand for microbiological resources for agriculture,

and feasibility studies on low-volume production and its location;

- searching for and creating promising strains of microorganisms producing microbiological plant protection resources, and developing new preparations on their basis;
- developing the principles of creating all-purpose mechanized lines (units, modules) for large-scale breeding of insects;
- creating genetic selection methods of selecting fungal producer strains that would work under the conditions of subsurface fermentation;
- creating artificial nutrient media for entomopathogenic microorganisms;
- developing the methods and principles of creating optimum preparative forms;
- developing regulations on producing new microbiological resources adapted to regional production of agricultural crops;
- improving and creating commercial forms of biopreparations intended for specific purposes—for seed treatment, for plant spraying and for soil application;
- developing methods by which to assess the quality of microbiological resources, and unified standards in application to regional production;
- planning individual, basic and standard models of regional low-volume production operations;
- developing ecological and economic criteria of using microbiological preparations and regional procedures of their use.

Fundamental research aimed at finding microbiological resources is to be continued in scientific research institutes of the Russian Academy of Sciences and the Russian Ministry of Health, as is applied experimental design work aimed at creating microbiological preparations at the State Scientific Research Institute of Applied Microbiology.

There are plans for supporting specific financing of fundamental research aimed at creating experimental industrial low-volume production operations, and for revamping the research base and developing experimental industrial facilities for low-volume production operations in the VIZR, VNIIF and SK NIIF.

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#### Proposed Program for Manufacture of Biological and Chemical Pesticides

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[Article by Yu. M. Veretennikov, chief specialist, Agrosa LTD, and A. K. Lysov, director, mechanization laboratory, VIZR: "From Policy to Practical Deeds"]

[Text] Efforts to solve a problem upon which both the country's food sufficiency and the health of its citizens depend to a considerable degree have been at a standstill for many years. The problem? A perpetual shortage and low quality of equipment for pesticide application. With

the disintegration of the USSR the situation has worsened even more—there are practically no specialized enterprises manufacturing sprayers left in Russia.

Machines made by the only plant in the CIS, Lvovkhim-selkhoz mash (in Ukraine), require significant improvement, and moreover, they are supplied to Russia at monopoly prices that are unjustifiably high. The situation is also aggravated by the fact that the sprayers presently available in the countryside are not only obsolete but also almost completely worn out. This means that growth of harvest losses and of the ecological danger is inevitable, because pesticides will be used no matter what, employing primitive methods and various contrivances.

All of this is happening at a time when the latest models of spraying equipment of various modifications and purposes that are competitive even in the foreign market have been created in Russia. Their advantages were confirmed by extensive field tests in different regions of the former USSR in the period from 1971 to 1991. Because the demand of Russian agriculture for such equipment is enormous, it would be suitable to establish a subsector based on qualitatively new spraying procedures, and to encourage defense industry enterprises to contribute their resources.

The Agros LTD partnership, the VIZR [All-Union Institute of Plant Protection], the VISKhOM [All-Union Scientific Research Institute of Agricultural Machine Building] and the KBM [not further identified] of the Department of Defense Industry have united their efforts and proposed an innovative program to the government of the Russian Federation titled the "Complex of Work to Organize Production of Technical Resources for Application of Chemical and Biological Plant Protection Resources and Plant Growth Regulators on the Basis of New Procedures Characterized by Minimum Ecologically Safe Consumption Norms," which is written for 1993-1996. The Russian Federation Agroindustrial Union was the client for the program.

Introduction of this innovative program into Russian agriculture will make it possible:

- to reduce the energy- and material-intensiveness of production systems in comparison with existing ones by 1.5-2 times;
- to create a system of special equipment for high-precision application of pesticides and biologically active substances of a new generation with consumption rates from 1 to 100 gm/ha, thus ensuring clear patent rights and competitiveness of the machinery in the domestic and foreign markets;
- to reduce the consumption rate of the preparations employed by 1-3 times (for different types of preparations) by purposeful processing of plants with prescribed parameters and controllable drop size, which will have a positive effect on the ecological situation of agricultural communities;
- to raise the effectiveness and uniformity of application of a preparation to the object of application, as a

result of which entry of toxic chemicals into the environment will decrease by 2-10 times, and loss of expensive preparations will drop;

- to introduce resources into agricultural practice for monitoring and automating control of production processes used to apply chemical and biological plant protection resources;
- to reach the posed objectives in coordination with regional "Saving the Black and Azov Seas" programs, and with projects in contiguous fields of science and engineering, and in particular, decontamination of areas subjected to radioactive contamination by the accident at the Chernobyl Nuclear Power Plant.

We hope that this program will be adopted by the government. It's time from us to move on from policy to practical deeds!

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## BIOTECHNOLOGY

### Obtaining Monoclonal Antibodies to Thyroxin

947C0145A Moscow BIOORGANICHESKAYA  
KHIMIYA in Russian Vol 19 No 7, Jul 93 (manuscript  
received 30 Dec 92) pp 704-712

[Article by N.P. Danilova, N.V. Krupina, M.V. Merts, and R.G. Vasilov, Biotekhnologiya Scientific Production Association, Moscow; UDC 577.175.444.083.3]

[Abstract] Most immunoassay methods of determining thyroxin are based on polyclonal sera. In most cases, this does not present any problems with respect to specificity of the said antibodies. Problems do arise in cases of antisera with a low titer resulting from the presence of endogenous thyroxin in immunized animals. A portion of the binding centers on the antibodies with the highest affinity are then occupied by endogenous thyroxin. This is a common problem in obtaining antibodies to endogenous compounds that can be overcome by using monoclonal antibodies. Monoclonal antibodies to thyroxin with binding constants of  $1.96 \times 10^9$  and  $2.6 \times 10^9 \text{ M}^{-1}$  for the high-affinity antibodies have been obtained in several laboratories. Monoclonal antibodies have now been obtained that have a binding constant of  $3 \times 10^9 \text{ M}^{-1}$ . The new monoclonal antibodies were obtained by immunizing BALB/c mice with keyhole limpet hemocyanin and thyroxin conjugate and then fusing spleen cells from the immunized mice with P3-X63-Ag8.653 mouse myeloma cells. Polyethylene glycol 4000 was used as a fusing agent. About 400 clones formed in one hybridization. The four highest-affinity monoclonal antibodies (9T, 1B7, 2E10, and 10F9) were selected by enzyme-linked immunosorbent assay [ELISA] and partially characterized. The four monoclonal antibodies all manifested good binding with thyroxin, but they differed greatly from one another with respect to affinity to triiodothyronine. The hybridoma producing the said



monoclonal antibodies grew well in ascites tumors. Antibodies were isolated from ascites by ion-exchange chromatography. According to gel-electrophoresis data, the ascites contained only one type of antibody, i.e., 1B7. 1B7 was determined to belong to the IgG1 subclass and to have a cross-reactivity with triiodothyronine of less than 1 percent and an affinity constant of  $3 \times 10^9 \text{ M}^{-1}$ . Further studies to determine the possibility of using the new antibodies in immunoassay of thyroxine established that 8-aniline-1-naphthalenesulfate in rather high concentrations (0.05 percent) did not affect antibody-antigen binding. The calibration curve obtained for thyroxine measurement was linear in log coordinates at thyroxine concentrations of 10 to 400 ng/ml. Figures 4; references 8 (Russian).

#### **Cyclic Nucleotides and Inositol Triphosphate as Biochemical Modulators of Permeability of Ion Channels in Receptor Domains**

937C0094A Moscow BIOKHIMIYA in Russian Vol 58 No 1, Jan 93 [manuscript submitted 20 Feb 92] pp 81-97

[Article by S. A. Talako, Institute of Toxicology, Russian Ministry of Health, St. Petersburg; UDC 577.352.4]

[Abstract] The work reported here is based on the assumption of dynamic domain organization of receptor molecules in biological membranes. According to that concept, the receptor molecules are structural elements of the cyclic process of the formation and decay of receptor domains, and they catalyze biochemical cell transformations, transport substances across membrane barriers, and generate cyclic electrical and biochemical changes. Cyclomononucleotides and inositol triphosphate operate as biochemical modulators of ion-channel permeability by blocking  $\text{Ca}^{2+}$  binding centers of gate mechanisms of receptor-domain ion channels, thereby mobilizing  $\text{Ca}^{2+}$  ions in the cell from intracellular calcium depots and from the surrounding medium. Kinetic diagrams of the operation of the gate mechanisms are provided for instances in which ions or molecules capable of blocking just one  $\text{Ca}^{2+}$  binding center are present along with the  $\text{Ca}^{2+}$  ions. Figures 7, references 44: 6 Russian, 38 Western.

#### **Bse118 I: Novel Isoschizomer of Restrictase Cfr10 I Isolated From Thermophilic Bacterium Bacillus Coagulans**

947C0055A Moscow BIOORGANICHESKAYA KHIMIYA in Russian Vol 19 no 4, Apr 93 (manuscript received 17 Jul 92; in final form 26 Nov 92) pp 406-410

[Article by V.Ye. Repin, I.V. Babkin and T.A. Tereshchenko, Scientific Research, Engineering and Technology Institute of Biologically Active Substances, "Vektor" Scientific Industrial Association, Berdsk; "VALPEK, Ltd." Stock Company, Novosibirsk; UDC 577.152.314'14]

[Abstract] Screening studies of soil bacteria for restriction endonucleases led to the isolation of restrictase Bse118 I from the thermophilic bacterium *Bacillus coagulans* 118. Determinations of the activity spectrum on a series of phages resulted in the identification of the (5')R\*CCGGY as the target sequence, where \* indicates the cleavage site, R = A or G, and Y = C or T. Specificity of Bse118 I identifies it as an isoschizomer of Cfr10 I. Maximum Bse118 I activity was expressed under the following conditions: 10 mM tris-HCl buffer, pH 7.5, 50 mM NaCl, 10 mM  $\text{MgCl}_2$ , 7 mM 2-mercaptoethanol, and 65°C. Figures 2; references 7: 3 Russian, 4 Western.

#### **Bco116 I: Novel Isoschizomer of Restrictase Ksp632 I**

947C0055B Moscow BIOORGANICHESKAYA KHIMIYA in Russian Vol 19 no 4, Apr 93 (manuscript received 26 Aug 92; in final form 6 Oct 92) pp 410-413

[Article by V.Ye. Repin, V.Ye. Chizhikov, T.A. Tereshchenko and L.R. Lebedev, Scientific Research, Engineering and Technology Institute of Biologically Active Substances, "Vektor" Scientific Industrial Association, Berdsk; "VALPEK, Ltd." Stock Company, Novosibirsk; UDC 577.152.314]

[Abstract] Screening studies of soil bacteria for restriction endonucleases led to the isolation of restrictase Bco116 I from the thermophilic bacterium *Bacillus coagulans* 116. Determinations of the activity spectrum on a series of phages resulted in the identification of the following nucleotide sequence as the target site: (5')-CTCTTCN-NNNN-(3')-GAGAAGN NNNN-, where - indicates cleavage points. Specificity of Bco116 I identifies it as an isoschizomer of Ksp632 I. Maximum Bco116 I activity was expressed under the following conditions: 10 mM tris-HCl buffer, pH 7.9, 100 mM NaCl, 10 mM  $\text{MgCl}_2$ , 1 mM dithiothreitol and 60°C. Figures 2; references 10: 3 Russian, 7 Western.

#### **Preparation and Bacterial Expression of Human Lymphotoxin Gene (TNF[GB])**

947C0055C Moscow BIOORGANICHESKAYA KHIMIYA in Russian Vol 19 no 4, Apr 93 (manuscript received 12 Oct 92) pp 414-419

[Article by V.G. Korobko, I.V. Davydov, V.N. Dobrynin, N.M. Pustoshilova\*, L.R. Lebedev\*, I.P. Gileva\* and V.A. Petrenko\*, Institute of Bioorganic Chemistry imeni M.M. Shemyakin and Yu.A. Ovchinnikov, Russian Academy of Sciences, Moscow; \*Scientific Research, Engineering and Technology Institute of Biologically Active Substances, "Vektor" Scientific Industrial Association, Berdsk, Novosibirsk Oblast; UDC 577.113.6:579.(252.5+253.4).083]

[Abstract] A 24-base oligonucleotide was used for the preparation of a mutant gene of human lymphotoxin (tumor necrosis factor  $\beta$ ) lacking 21 N-terminal codons. The mutant gene was then introduced into plasmid

pLT21, constructed by recombination of plasmid pLT18 with phage M13LT2. pLT21, with the lymphotoxin gene controlled by tandem constitutive T7 coliphage promoters, was employed in the transformation of *E. coli* SG20050. Ultrasonication of the transformed *E. coli* cells and successive chromatography of the supernatant on DEAE-cellulose DE-52 and hydroxyapatite yielded 5.6 mg of the recombinant protein per 3 g of wet cells. Cytopathic activity of the preparation on L-929 murine fibroblasts was on the order of  $5 \times 10^7$  U/mg protein. Figures 3; references 24: 9 Russian, 15 Western.

#### Expression and Characteristics of Recombinant Metastasin

947C0055C Moscow BIOORGANICHESKAYA  
KHIMIYA in Russian Vol 19 no 4, Apr 93 (manuscript  
received 15 Oct 92) pp 420-426

[Article by M.A. Neyra Kardenas, M.F. Vorovich, A.K. Ebralidze, O.Yu. Chertov\* and Ye.M. Lukanidin, Institutes of Gene Biology and of \*Bioorganic Chemistry imeni M.M. Shemyakin and Yu.A. Ovchinnikov, Russian Academy of Sciences, Moscow; UDC 577.2:577.112]

[Abstract] In order to obtain adequate quantities of metastasin (mst-1)—an S-100 $\beta$  protein—for biological studies, genetic engineering was employed for the construction of an expression vector for transformation of *E. coli*. Transformation of *E. coli* with plasmid pMAL-C bearing the mst-1 gene yielded approximately 40 mg of recombinant metastasin from 5 g of wet cells. The recombinant product was longer than the native peptide by an additional 13 amino acid residues on the N-terminal end. However, its ability to bind calcium ions was not affected. Thus, the tertiary structure of the recombinant metastasin appears to differ little from the native protein and should be suitable for biological investigations, including the generation of poly- and monoclonal antibodies. Figures 3; references 33 (Western).

#### Oligodeoxyribonucleotides Bearing 2'-Amino-2'-Deoxypyrimidine Nucleosides

947C0055F Moscow BIOORGANICHESKAYA  
KHIMIYA in Russian Vol 19 no 4, Apr 93 (manuscript  
received 15 Jun 92) pp 455-466

[Article by L.G. Kuznetsova, Ye.A. Romanova, Ye.M. Volkov, V.N. Tashlitskii, T.S. Oretskaya, N.F. Krynetskaya and Z.A. Shabarova, Chemical Faculty, Moscow State University imeni M.V. Lomonosov; UDC 547.963.32.057:542.95]

[Abstract] Automated solid-phase amidophosphate methods (Victoria-4M and Applied Biosystems 380B systems) were employed for the synthesis oligodeoxyribonucleotides containing 2'-amino-2'-deoxyribo- pyridine nucleosides residues. The 12 compounds

were 5 to 20 nucleotides long, some of which corresponded to stretches of 5S rRNA of *E. coli*. Oligonucleotides bearing 2'-amino-2'-deoxyribo- pyridines withstood acid hydrolysis, with the amino groups undergoing acetylation and reacting with FITC to form fluorescent compounds. CD spectra and melting studies showed that the 2'-amino-2'-deoxyribo- pyridine moieties destabilized DNA-duplexes. Comparative evaluation indicated that such derivatized oligodeoxyribonucleotides with a high G:C content may find application as hybridization probes; similar arguments apply to derivatives with modifications on the 3'- or 5'-ends of the oligonucleotides. Figures 6; Tables 1; references 19: 6 Russian, 13 Western.

#### Porphyrin Derivatized Oligonucleotides. Part 1. Synthesis of 2,4-DiA- (Hydroxyethoxy) Ethyl] Deuterophorphyrin IX (DDP) and Fe(III)DDP and Assessment in Oxidative Modification of DNA

947C0055F Moscow BIOORGANICHESKAYA  
KHIMIYA in Russian Vol 19 no 4, Apr 93 (manuscript  
received 27 Apr 92; in final form 14 Jul 92) pp 439-454

[Article by Ye.I. Frolova, Ye.M. Ivanova, N.I. Komarova, A.S. Rayt, V.V. Vlasov, G.V. Ponomarev\* and G.V. Kirillova\*, Novosibirsk Institute of Bioorganic Chemistry, Siberian Branch, Russian Academy of Sciences; \*Institute of Biophysics, Ministry of Health, Moscow, Russia; UDC 577.113.4/6]

[Abstract] Homogenous phosphotriesterase synthesis was employed for the preparation of oligonucleotides derivatized on the 5'- or 3'-ends with DDP or Fe(I-II)DDP in 15-30 min in yields approaching 95%. Both agents were effective in modifying DNA, particularly Fe(III)DDP in the presence of hydrogen peroxide. The reaction mechanisms involved covalent adduct formation adjacent to a guanosine duplex, direct scission of the DNA, as well as molecular lesions that led to DNA cleavage after addition of piperidine. In analogy to porphyrins, the derivatized oligonucleotides also bound to HeLa, bone marrow and Krebs-2 ascitic carcinoma cells. These observations support the contention that oligonucleotides derivatized with DDP and Fe(III)DDP may have applications in modifying gene expression. Figures 7; Tables 1; References 31: 7 Russian, 24 Western.

#### Immunochemical Analysis of Radianthus Macroductylus Neurotoxins

947C0107A Moscow BIOORGANICHESKAYA  
KHIMIYA in Russian Vol 18 no 3, Apr 92 (manuscript  
received 05 Jun 91; in final form 27 Sep 91) pp 374-382

[Article by T.V. Shvets, E.P. Kozlovakaya and A.N. Filitov, Pacific Institute of Bioorganic Chemistry, Far Eastern Oblast, Russian Academy of Sciences, Vladivostok; UDC 577.112.083.3]

[Abstract] An immunochemical assessment was carried out on neurotoxin RM-III of the sea anemone *Radianthus macrodactylus* using specific polyclonal rabbit IgG antibodies. Solid-phase immunoenzyme studies showed that native Rm-III reacted with the antibodies with and  $I_{50}$  of  $1.4 \times 10^{-9}$  M. Inhibition studies involving the anti-Rm-III antibodies and related toxins with diminishing homologies with Rm-III yielding showed a rise in  $I_{50}$  to  $3.7 \times 10^{-6}$  M for the least homologous toxin. Correlation of the immunochemical findings with amino acid sequences showed that the epitopes of the homologous toxins share identical structural dispositions that encompass amino acids at positions 2, 11, 20, 28 and 46-48. Figures 3; tables 3; references 29: 6 Russian, 23 Western.

#### Immunochemical and Functional Assessment of Latrotoxin

947C0107B Moscow BIOORGANICHESKAYA  
KHIMIYA in Russian Vol 18 no 3, Apr 92 (manuscript received 11 Sep 91; in final form 28 Nov 91) pp 383-390

[Article by V.N. Pashkov, G.I. Kovalevskaya, N.B. Griko, O.V. Bulgakov, Ye.B. Yakhnina, Ye.V. Nikolishina\*, L.G. Storchak\*, O.Y.A. Shaturskiy\*, N.G. Gimmelreykh\* and Ye.V. Grishin, Pushchino Branch, Institute of Bioorganic Chemistry imeni M.M. Shemyakin, Russian Academy of Sciences, Moscow Oblast; \*Institute of Biochemistry imeni A.V. Palladin Ukrainian Academy of Sciences, Kiev] UDC 577.27:547:615.91:591.044]

[Abstract] Monoclonal antibodies against  $\alpha$ -latrotoxin (LT) isolated from the venom of the spider *Latrodectus mactans tredecimguttatus* were tested for their impact on LT-mediated physiological effects. The findings showed that none of the antibodies inhibited LT binding to rat brain synaptosomes, but may interfere with channel-forming and/or secretogenic functions. Calcium permeability of synaptosomes was not affected by 2 antibodies (A15, A19), but completely abolished by 3 (A4, A6, A24). Two antibodies (A6 and A24) blocked GABA release from synaptosomes, while one (A4) was only partially inhibitory. In addition, A15 and A19 did not affect GABA release. In combination with studies on channel formation in BLM (in no case was insertion of LT into BLM completely abolished by an antibody), these observations demonstrated that binding and channel-forming functions of LT can be uncoupled. Therefore, the data indicate that LT possesses several functional sites. These include a receptor-binding site, a site for channel formation with calcium-dependent secretogenic effect, a site for calcium-independent secretogenic effect, and a site

promoting channel formation in BLM. Figures 3; tables 1; references 21: 4 Russian, 17 Western.

#### E. Coli Expression Systems for Human Interleukin-3

947C0107C Moscow BIOORGANICHESKAYA  
KHIMIYA in Russian Vol 18 no 3, Apr 92 (manuscript received 11 Jul 91) pp 391-397

[Article by S.V. Lutsenko, A.I. Gurevich, L.R. Ptitsyn, L.A. Ryazanova and V.A. Smirnov, Institute of Bioorganic Chemistry imeni M.M. Shemyakin, Russian Academy of Sciences, Moscow; UDC 577.112:577.113.6.088:547.963.32.057]

[Abstract] Various strains of *E. coli* were tested for efficiency in expression of the human interleukin-3 (HIL3) gene borne by plasmids pTOTE2IL3 (induced biosynthesis) or pTE2IL3 (constitutive). The results showed that under appropriate combinations of expression vector and host HIL3 yields approached 30-40% of total cell protein. Such optimal combinations were represented by *E. coli* HB101 and pTEIL3, and *E. coli* TG1 and pTOTE2L3. Precipitation, ultrafiltration and purification via HPLC provided IL3 preparations with a purity of > 98% and a specific activities on the order of  $5 \times 10^6$  U/mg. Figures 6; tables 1; references 6: 2 Russian, 4 Western.

#### Preparation of Enzymatic Hydrolysates of Casein With Reduced Phenylalanine Content

937C0058B Moscow PRIKLADNAYA BIOKHIMIYA I  
MIKROBIOLOGIYA in Russian Vol 29 No 3,  
May-Jun 93 (manuscript submitted 3 Jan 92)  
pp 398-403

[Article by P. Moshchinskiy, Ya. Idzyak, Technical University, Lodz, Poland; UDC 542.938]

[Abstract] Protein hydrolysates with low phenylalanine content represent the principal component of the protein diet of children suffering from phenylketonuria, a disease associated with a congenital disorder of the phenylalanine metabolism and the result of genetic blocking of the oxidation of that amino acid into tyrosine. Devising low-phenylalanine diets that use proteins of plant or animal origin capable of countering that problem is difficult because phenylalanine shows up in all nutritional proteins in rather large quantities. The primary raw material for producing low-phenylalanine hydrolysates is casein, which is easily assimilated by a child's body and is readily available. Casein undergoes specific enzymatic hydrolysis for what is possibly the most complete release of phenylalanine from the polypeptide



chain, the phenylalanine then being removed from the hydrolysate with a number of techniques. The researchers here developed optimum parameters for the targeted enzymatic hydrolysis of casein. Much of the phenylalanine was removed from the hydrolysate via adsorption on activated charcoal, ion-exchange resins, or molecular sieves. After adsorption on activated charcoal, the phenylalanine content was 0.3 mg/ml or less, which makes possible the production of dry preparations with a phenylalanine content of about 1 mg/ml. Figures 2, references 11: 1 Russian, 5 Polish, 3 Western, 1 GDR, 1 Japanese.

#### Study of Resistance of Liposomes as Potential Drug Vehicles to Phospholipase A<sub>2</sub>

937C0058E Moscow PRIKLADNAYA BIOKIMIYA I MIKROBIOLOGIYA in Russian Vol 29 No 3, May-Jun 93 [manuscript submitted 25 Sep 91] pp 478-484

[Article by N. M. Litvinko, T. A. Shumilina, M. K. Naubatova, A. A. Akhrem, Institute of Bioorganic Chemistry, Belarus Academy of Sciences, Minsk; UDC 577:152.3]

[Abstract] In a study of the in vitro resistance of varying compositions of liposomes to phospholipase A<sub>2</sub>, the researchers used phosphatidylcholine, phosphatidylglycerine, phosphatidylinosite, phosphatidylethanolamine, and their mixtures with sphingomyelin to prepare the liposomes. Liposome stability was studied with liposomes consisting of an equimolar mixture of phosphatidylcholine and phosphatidylglycerine in phospholipase hydrolysis in the presence of cytochrome c, cytochrome b<sub>5</sub>, cytochrome P<sub>450</sub>, polylysine, and the histone H<sub>1</sub>. Twenty minutes after the beginning of the reaction in the sphingomyelin-containing liposomes, some 65 percent of the phosphatidylglycerine remained. The amount of phosphatidylinosite left was 62 percent; phosphatidylethanolamine, 55 percent; phosphatidylcholine, 50 percent. When phosphatidylglycerine was incorporated into the liposomes, phosphatidylcholine content after processing with phospholipase A<sub>2</sub> was 15-20 percent higher than in control. The researchers found that the presence of the proteins had a strong stabilizing effect on the components of binary liposomes (with phosphatidylglycerine and phosphatidylcholine), but virtually no effect on single-component liposomes. Binary liposomes incorporating negatively charged phosphatidylglycerine were found to be the most resistant to phospholipase A<sub>2</sub>. That was attributed to the asymmetric distribution of the phospholipids between the outer and inner layers of the phospholipid vesicles. That the liposome surfaces were screened by the proteins was viewed as possible, as was the electrostatic interaction of positively charged proteins present in the surrounding medium and the negatively charged lipid component, which would partially protect the liposome from lipolytic enzymes. Figures 2, references 16: 4 Russian, 12 Western.

#### Nature and Interaction of Components of Law of Preservation of Sterility

937C0072 Moscow SENSORNYE SISTEMY in Russian Vol 6 No 4, Oct-Nov-Dec 92 [manuscript submitted 25 Feb 92] pp 103-106

[Article by Ye. V. Shevchenko, Ye. Yu. Smirnova, V. F. Antonov, Moscow Medical Academy imeni I. M. Sechenov; UDC 612.81.814]

[Abstract] The conformational changes in a membrane that are due to a change in temperature, pH, Me<sup>2+</sup>, or electrical field represent one possible mechanism of the appearance of electrical signals in receptor membranes and excitable membranes. Information in living organisms is transferred via electrical impulses, which means that, at the membrane level, there must be elements that transform every possible type of external event into electrical signals. The transformation mechanism is localized in the cell membrane, which contains receptor structures and is capable of generating an electrical response. Membrane potentials arise as a result of the selective diffusion of ions through individual transmembrane pores. The bilayer lipid membrane has trigger properties that are important from the standpoint of sensory systems, i.e., in physiological systems, it can be in two conformational states (gel and liquid crystalline). Experiments on flat bilayer lipid membranes have demonstrated that when a fixed voltage is present on a membrane, the transition from liquid-crystalline state to gel phase is accompanied by electrical signals that are ionic and capacitive. Membranes consisting of charged lipids are of particular interest to researchers, because they are sensitive to the external environment and to exposure to protons, divalent ions, pressure, and electrical field. The researchers here use measurements of electrical parameters in phase transformations induced by changes in Me<sup>2+</sup> concentration in bilayer lipid membranes consisting of acidic lipids to demonstrate that the phase transition is accompanied by capacitive currents comparable in magnitude and direction to the so-called gate currents of excitable membranes and by increased permeability for cations. Figures 2, references 9: 3 Russian, 6 Western.

#### Biosynthesis of Cellulolytic-Complex Protein and Enzymes by the Micromycete *Aspergillus* sp. on Corn Cobs

937C0058D Moscow PRIKLADNAYA BIOKIMIYA I MIKROBIOLOGIYA in Russian Vol 29 No 3, May-Jun 93 [manuscript submitted 23 Oct 91] pp 437-441

[Article by A. V. Nazarenko, V. N. Sokolov, A. I. Ginak, B. S. Ostrer, St. Petersburg Technical Institute; UDC 502.7:276.8]

[Abstract] The natural exoenzymatic decomposition of lignocellulose is performed by aerobic bacteria, actinomycetes, and fungi in ecological microbial succession. Technologies for the microbial conversion of cellulose to produce protein, glucose, alcohol, and fuels are being

developed on that basis. But the supramolecular structure of cellulose and its association with other components of the plant cell—specifically, lignin and hemicellulose—represent a serious obstacle to enzymatic attack and effective conversion. Although chemical processing of substrates is widely used to raise nutritional value and to intensify the processes of biotransformation, reagents are difficult to regenerate, equipment has strict requirements, and the process is expensive. Since depolymerases of symbiotic microorganisms effect decomposition in natural biocenoses, the researchers here chose to examine rapidly growing micromycetes that produce an entire complex of depolymerases. The most promising such micromycetes, in their view, were strains of the *Aspergillus* fungus, because they produce a broad range of hydrolytic enzymes. The researchers used *Aspergillus* sp. VKM MF-559 in the direct conversion of corn cobs. The protein yield over an 18-hour period of cultivation was 17.2 percent, with 80 percent utilization of cellulose. Figures 2, references 21: 9 Russian, 12 Western.

#### Isolation and Description of Propane-Assimilating Bacteria

937C0058C Moscow PRIKLADNAYA BIOKHIMIYA I MIKROBIOLOGIYA in Russian Vol 29 No 3, May-Jun 93 [manuscript submitted 30 Sep 91] pp 431-436

[Article by A. K. Kulikova, Ye. V. Letunova, A. M. Bezborodov, Institute of Biochemistry imeni A. N. Bakh, Russian Academy of Sciences, Moscow; UDC 579.87]

[Abstract] Enzymes produced by microorganisms have been used in recent years to produce compounds such as epoxides. Certain epoxides—ethylene oxide and propylene oxide, in particular—serve as the raw material for the synthesis of many polymer-chemistry materials. An active enzyme system that catalyzes the reaction of formation of those epoxides is found solely in microorganisms that use gaseous alkanes as the carbon source. Microorganisms that use propane and butane as the carbon source, however, are little studied, although papers devoted to propane-utilizing microorganisms first appeared in the early 1980s and, in the last two years, have focused on the study of the metabolism of propane and various enzymes. Interest in the distinctive properties of an enzyme system that effects a reaction of hydrooxidation prompted the researchers here to isolate strains of microorganisms that grow on propane, describe the strains, and study the conditions underlying the cultivation of the microorganisms to produce a biomass that can be used in the reaction associated with the epoxidation of propylene into propylene oxide. Out of 85 cultures studied, they managed to produce a culture—*Rhodococcus erythropolis* 3/89—that, when grown in an atmosphere of propane, evidenced an active monooxygenase enzyme system in the cells of the microorganisms, the system being capable of catalyzing the

sought-after epoxidation. The culture uses alcohols ( $C_2$ - $C_4$ ), the monosaccharide  $C_6$ , and disaccharides, as well as the salts of certain organic acids. References 22: 2 Russian, 20 Western.

#### Coriolus hirsutus Laccase—A New Marker Enzyme for Enzyme Immunoassay

937C0058A Moscow PRIKLADNAYA BIOKHIMIYA I MIKROBIOLOGIYA in Russian Vol 29 No 3, May-Jun 93 [manuscript submitted 30 Sep 91] pp 354-361

[Article by O. V. Skorobogatko, A. L. Gindilis, A. M. Shuster, Ye. N. Troitskaya, A. I. Yeroplov, Institute of Biochemistry imeni A. N. Bakh, Russian Academy of Sciences, Moscow; UDC 577.152.9]

[Abstract] Enzyme immunoassay is widely used in biology, medicine, and the food industry because of its high level of sensitivity, which is primarily the result of the marker enzyme/ligand conjugates used in the analysis. The researchers here create conjugates consisting of a ligand and laccase extracted from the culture fluid of *Coriolus hirsutus*, and they use the reagents in various enzyme immunoassays and compare the properties of the reagents with those of immunoperoxidase conjugates. The laccase conjugates can be used in sandwich, concurrent, and indirect EIA. The absolute sensitivity of laccase/antibody conjugates was shown to be threefold higher than that of similar peroxidase conjugates ( $7.7 \times 10^{-11}$  M versus  $2.3 \times 10^{-10}$ ). The use of laccase conjugates simplifies the assay process by its use of atmospheric oxygen as a second substrate for the enzymatic reaction. Figures 5, references 17: 4 Russian, 13 Western.

#### EPIDEMIOLOGY, MICROBIOLOGY, AND VIROLOGY

##### Survival of Embryonal Supraoptic and Paraventricular Nuclei of the Human Hypothalamus Into the Cavities of the Third Ventricle of the Rat Brain

937C0036B Moscow ONTOGENEZ in Russian Vol 24 No 5, May 93 [manuscript submitted 24 Jun 92; resubmitted 28 May 93] pp 80-85

[Article by O. A. Kim, V. N. Yarygin, G. V. Chernykh, Russian State Medical University, Moscow; UDC 612.826.4.018.014.2:612.6.02]

[Abstract] In studying the survival capabilities of xenotransplantates of embryonal neurosecretory nuclei of the human hypothalamus in the rat brain and the morphogenesis of neurosecretory cells, the researchers here transplanted the nuclei into 30 mature female white rats. The transplants survived in 11 rats (36.7 percent) as clusters of neural and glial cells.  $^3H$ -thymidine was incorporated into the neurosecretory cells to varying degrees. The most active proliferation of neuroblasts was found in rats injected with the  $^3H$ -thymidine four weeks or eight weeks after the transplantation. Rats injected 16

weeks after transplantation demonstrated a considerably lower level of proliferation. Average volume of nuclei and nucleoli grew with time. The degree of differentiation of large-cell supraoptic and paraventricular neurons in the transplanted tissue varied as it would in normal ontogenesis. Figures 3, references 18: 8 Russian, 10 Western.

#### **Behavior of Embryonal Nerve Cells Transplanted Into a Brain**

937C0036A Moscow *ONTOGENEZ in Russian* Vol 24 No 5, May 93 [manuscript submitted 3 Dec 92; resubmitted 12 Apr 93] pp 43-50

[Article by M. A. Aleksandrova, Ye. V. Loseva, I. V. Yermakova, Institute of Developmental Biology imeni N. K. Koltsov, Russian Academy of Sciences, Moscow; Institute of Higher Nervous Activity and Neurophysiology, Russian Academy of Sciences, Moscow; UDC 591.089.84.612]

[Abstract] Transplantation of embryonal neural tissue is a widely used technique because it makes it possible to stimulate regeneration processes in the brain and to adjust a whole array of disrupted CNS functions. The researchers here studied the behavior of cells after migration in an embryonic cortex and after transplantation into the cortex of intact female Wistar rats in order to determine, specifically, the nature of the migration demonstrated by neurons and glial cells and the positions occupied by the migrating neurons of the transplantate in the brain of the recipient. The label for the donor cells,  $^3\text{H}$ -thymidine, was injected intraperitoneally twice a day on days 12, 13, and 14 of the pregnancy, so as to incorporate the isotope in the neurons of layers 1, 5, and 6 and in the nuclei of some astrocytes. The embryos were removed on day 20, and cortical fragments were transplanted. The animals were sacrificed on day 50 and studied. Transplanted cells that had migrated were clearly visible in 6 rats. The distribution throughout the brain of glial cells that had migrated was much broader than that of the neurons and was similar to the movement of astrocytes from the suspension grafts. Postmigration neurons were found to be capable of repeated migration. No large neurons, however, migrated. No donor neurons migrated to the layers of their origin, i.e., neurons from layers 1, 5, and 6 were found in layers 2 and 3. Figures 6, references 32: 3 Russian, 29 Western.

#### **Systematic Analysis of Compartmental Pharmacokinetics in Hygienic Toxicology**

947C0100A Moscow *GIGIYENA I SANITARIYA in Russian* No 5-6, 92 [manuscript received 10 Jan 91] pp 9-13

[Article by B.A. Katsnelson, V.S. Bezel and L.K. Konyshva, Medical Scientific Center for Prevention and Health Protection at Industrial Plants, Yekaterinburg; UDC 613.632-07:001.5]

[Abstract] Descriptive analysis was conducted on the application of compartmental models in toxokinetics, using examples dealing with several Cr, F, B, Pb and Zn compounds. A review of available information points to the advantages of the compartmental approach to the pharmacokinetics of toxicants, rather than reliance on a generalized system data. The key factor in compartmental analysis is the flexibility with which individual tissues, organs or body fluids of interest can be monitored and analyzed for kinetic parameters, with information on the different compartments then combined for an overall assessment. Figures 2; references 20: 17 Russian, 3 Western.

#### **Reserpine Effects in Experimental Rabies**

937C0440B Moscow *VOPROSY VIRUSOLOGII in Russian* No 2, Mar-Apr 93 [manuscript received 04 Oct 91] pp 81-83

[Article by I.K. Zubovich, N.P. Mishayeva, V.I. Votyakov, N.A. Kovalev, A.S. Shashenko and G.P. Golovneva, Scientific Research Institute of Epidemiology and Microbiology, Ministry of Health, Minsk, Belarus; UDC 616.98:578.924.11]-092.9-02:615.214.22]-07]

[Abstract] Trials on albino mice and rabbits infected with wild or fixed rabies viruses demonstrated that reserpine exerted a dose-dependent protective effect. Survival rates of 40 to 83.4% prevailed in mice infected intramuscularly with 8-10 LD<sub>50</sub> viral dose and treated per os or intramuscularly with 0.01 or 0.05 mg/kg/day of reserpine (24 h before infection and for 1-2 days thereafter, or 30-60 min after infection and for 3-4 days thereafter). Analogous studies on rabbits yielded 100% survival vs. 33.3% for placebo controls. Reserpine treatment was also seen to prolong the incubation period two-fold. These observations indicate that reserpine may be a promising agent for use in combined therapy of rabies in conjunction with vaccines. Tables 2; references 10: 8 Russian, 2 Western.

#### **Penetration of Marburg Virus Into Eukaryotic Cells**

937C0440A Moscow *VOPROSY VIRUSOLOGII in Russian* No 2, Mar-Apr 93 [manuscript received 13 Dec 91] pp 74-76

[Article by R.F. Maryankova, S.Ye. Glushakova, Ye.V. Pyzhik and I.S. Lukashevich, Belarusian Scientific Research Institute of Epidemiology and Microbiology, Ministry of Health, Minsk; UDC 578.824:578.232].08]

[Abstract] The mechanism of ingress of Marburg virus (MV), strain Voegelé, into eukaryotic cells was deduced from studies involving modulation of penetration into Vero-E6 cell culture by the ionophore monensin and ammonium chloride (AC). Both agents, which act on lysosomes, inhibited replication of MV when added with the virus to the cell culture or used to pretreat the cells



before exposure to the virus. Complete inhibition was obtained with 20-30 mM AC in a dose-dependent fashion, while monensin gave a maximum yield reduction ( $> 3$  log units) at a concentration of 5  $\mu$ M. Treatment of the cells with AC 1-2 h after adsorption was ineffective. Furthermore, blockage by 20 mM AC was precluded by exposure of the virus-cell surface complex to pH 4.6 for 10 min to induce membrane fusion. These observations were interpreted to favor endocytosis as the mechanism by which MV enters target cells. Figures 3; references 7: (Western).

## MEDICINE AND PUBLIC HEALTH

### Nature and Interaction of Components of Principle of Preservation of Sterility

937C0058F Moscow PRIKLADNAYA BIOKHIMIYA I MIKROBIOLOGIYA in Russian Vol 29 No 3, May-Jun 93 [manuscript submitted 12 Mar 92] pp 492-496

[Article by V. L. Yarovenko, Moscow State Correspondence Institute of the Food Industry]

[Abstract] The interaction of the components of the principle of preservation of sterility in a multistage system is described as fermenter sterilization that is coincident with the inflow of the nutritive medium and the outflow of the mature culture fluid, with a clear-cut separation of the new and old fluids. The principle itself is such that if the movement of the fluid coincides with the successive prophylactic sterilization of the unoccupied parts of the viaduct, the controlled sterility of the fermentation medium is preserved, and the medium remains uncontaminated for an infinitely long time. As a corollary of that, if the prophylactic sterilization of individual parts of the viaduct coincides with the continuous movement of the fluid, the controlled (or initial) sterility is maintained for an infinitely long period of time. The researcher suggests that all biotechnology production be converted to the contamination-free continuous method, which will also result in a twofold gain in productivity. Figures 5, references 4 (Russian).

### Baby Food Shortage in Ukraine

947C0029A Moscow MEDITSINSKAYA GAZETA in Russian 26 Mar 93 p 5

[Article by correspondent Vasilii Kalita: "What Do You Feed an Infant?"]

[Text] We adults have gotten used to all kinds of deprivations. But what is an infant just born to the light of day to eat? This is a very urgent question in the Ukrainian capital.

A young mom inquired at one of the children's polyclinics in Kiev: "Doctor, please give me a prescription for some baby food. I can't find any, and he isn't breast

feeding...." A joke? Unfortunately, no. Mothers of newborn infants have started turning to doctors as a last resort.

### A Kitchen Where They Don't Make Anything

I went to the nearest children's dairy kitchen which, according to the idea, was supposed to provide assistance to mothers and children first. They looked at me like I had just fallen from the Moon:

"We don't make anything at all for newborn infants, but we do make some things for older children starting to eat solid food."

What is an unfortunate mom to feed an infant being raised on formula—that's 70 percent of the infants in the city, by the way?

As it turns out there are two solutions to our situation. The first is to go to the market and buy imported baby food there. But given an impoverished existence, far from every mother can allow herself to do this. You have to put out 1,500-2,000 karbovantsy in coupons for a package of formula. For some mothers this is a month's wages. The second option is left to them—going to the dairy store. After standing a couple of hours in line, such a mother would buy milk, dilute it, and give it to the youngster. If the child is a little older, she would prepare a gruel of some sort. But this is hardly what a youngster needs for normal development, just so that its legs would grow strong.

"Yes, that's the way it is," was the confirmation I got to my conclusions at the Main Territorial Medical Association under the state administration. "We are seriously troubled by this issue, and we've been trying to do something about it for a long time...."

In our city there are 28,000 youngsters up to 1 year old. Nutrition support is catastrophic. Given an annual demand for dry adapted—that is, prepared according to all of the rules—formulas of 705 tonnes, the trade system hasn't sold anything for the last year and a half. The absence of such food products forces parents to feed their youngsters whatever they can. And this raises morbidity and mortality.

Could it be the older youngsters are in a better position? If only that were true: Given a daily demand of 450,000 baby food portions, five times less is actually prepared for them.

And what can you ask those 13 dairy kitchens (for the entire population of 3 million) to do? Their output is low, they are primitive, with manual labor dominating. How can there be any discussion of quantity and quality of food products? And it is impossible to reequip them: All of them are set up in residential buildings, and you're not going to start filling them with industrial equipment.

So who can you count on? On the city's dairy industry? Yes, it does produce sterilized milk in 200 gm packages. But this is only 1.8 tonnes, as compared to a daily demand of 7.

The city is feeling an acute shortage of juices and of strained fruits and vegetables. The demand for them is 15-20 percent satisfied. The assortment is extremely limited.

With our life today being as difficult as it is, there are many needs to be met. In the opinion of some officials there are problems of even greater importance, and so this one—baby food—is relegated to the back burner. There's also the psychological set that somehow we'll squeak by with the help of a kind uncle. Yes, kind foreign uncles organizing humanitarian aid can be found. The city received a hundred tons of food for youngsters. It was immediately distributed among the rayons. However, this is but a drop in the ocean. And the spring is extremely unreliable—today it's flowing, but tomorrow it may dry up.

No, we need to resolutely seek and find our own domestic sources.

#### The Legacy—24 Decrees

This problem didn't of course come up just today, or even yesterday. It is a legacy of former times. The former Ukrainian Communist Party Central Committee and Ukrainian Council of Ministers adopted 24 decrees on this issue in the last few years. To what end? The Khorol and Balta baby food plants existing today in Poltava and Odessa oblasts have stopped putting out the products children need. It would have been nice to organize production of the popular baby food Vitalakt in Kiev, but beginning this year it will no longer be produced.

Ukrainian scientists and specialists in baby food have created other food products. Samples have been tested, and all of the requirements on goods of this kind have been observed—homogeneity, sterilized raw materials, preservation of nutritional value, modern preparation procedures. And all of this has been gathering dust on archive shelves for years on end. Is an enterprise that would accept responsibility for placing the developments of scientists into production, one which would work for the good of the children, really not to be found in a city of 3 million? And what about the farmers? If they wanted to, of course they could find the needed raw materials.

Baby food is not a public health problem. Nonetheless, the Main Territorial Medical Association of the state administration is energetically trying to get something going. S. Osipenko, a pediatrician by trade who knows her business well and the director of the association's department for safeguarding maternity and childhood, showed me a thick file of correspondence with higher and other bodies of administration. Medical workers have done more than just provide warnings of the disastrous situation—they offered and continue to offer

specific proposals that take the difficulties of the current economic situation in Ukraine into account.

The first proposal is, let us say, the minimum program: appropriating the needed amount of hard currency to the city for the purchase of baby food abroad.

Sima Ivanovna Osipenko showed me samples of such products. One is made by a Polish company—Bebiko. The mother places a few spoonfuls of the package contents in water, and a minute later she can feed her infant. Or there's strained corn produced by an Israeli company—tasty, nourishing, and extremely easy to manufacture.

It would be good to buy such things. But they are expensive, and beyond the means of many mothers. Subsidies are necessary. This is what the Main Territorial Medical Association took to the city's state administration.

But we also need to think about the maximum program—we can't buy food products abroad forever, we need to learn how to produce them ourselves. To finally surmount the disastrous situation, medical specialists propose, as a beginning, accelerating construction of a specialized shop at City Dairy No 4 in Minskiy Rayon, and a baby food factory-kitchen in Troyeshchina-Vygurovshchina producing 40,000 portions per shift.

But why has the health service been working alone on this problem all of these years? Why is the trade department, which could make a certain contribution to eliminating the shortage if it so desired, sitting on the sidelines?

Interested departments were convened at the offices of the state administration's department of food, trade and the consumer market in order to discuss this problem, and to finally come up with specific ways of solving it. Trade workers from the state-run company Kiyev were invited to the conference. The question of purchasing imported baby foods was thoroughly discussed. The Kiyev firm was directed to implement the proposal—in particular, to make contact with foreign firms and make the best deal. And so, what happened? A considerable amount of time has passed, but things still haven't gotten off the ground. There remains the maximum program—organizing our own production. Specialists unanimously agreed that this question has to be resolved at the state level. If we are unable to do so, we will be faced by a universal increase in the morbidity and mortality of young children, including infants up to a year old, and steady worsening of the demographic situation. Are we really going to let things slide until even more women decide not to have any children at all?



### Subsensory Reactions and the Problem of Unconscious Perception

947C0149A Moscow *SENSORNYE SISTEMY*  
in Russian Vol 7, No 3, Jul-Sep 93 (manuscript received  
25 Mar 93) pp 32-40

[Article by E.A. Kostandov., State Social and Forensic Psychiatry Scientific Center imeni V.P. Serbskiy, Ministry of Health, Russian Federation Ministry of Health, Moscow; UDC 612.82.8]

[Abstract] The work done by G.V. Gershuni and his associates in relation to subsensory reactions provided the first proof that the problem of unconscious perception in human psychology, specifically the problem of unconsciously perceived audio signals, may be resolved successfully by the natural science route by means of experimental physiological research. Gershuni's research in the area of humans' bioelectric and autonomic reactions to unconsciously perceived audio stimulation began in 1942 and ceased in 1950. During that relatively brief period, Gershuni developed the concept of the subsensory zone of human consciousness, i.e., that region of the unconscious state within whose confines stimuli not consciously perceived by a person can affect that person's mental and physiological functions. One of Gershuni's associates, A.M. Maruseva, made the interesting discovery that the intensity of audio stimulation sufficient for conscious perception by a person decreases by 10 dB upon repeated exposure to a given stimulant while that same person's cutaneogalvanic reaction and eye movements in response to the said stimulant will remain unchanged. Gershuni's research on various autonomic and bioelectric reactions to audio stimuli led him to the conclusion that the suppression of alpha-rhythm to sounds of different strength and simultaneously recorded cutaneogalvanic reactions are both components of an orientation reflex. Gershuni's thinking regarding the existence of a cortical electrical component of the orientation reflex and the concept of a multicomponent orientation reflex as a centrally integrated reaction has since been confirmed by others and has proved to be a very productive concept in the study of subsensory reactions. Gershuni identified two types of subsensory reactions. The first, either autonomic or bioelectric, is induced by trauma or hysteria (i.e., by brain pathology) and is manifested as a steady decrease in the excitability of the structures of a given sensory system. The second is observed under conditions of the normal activity of the human central nervous system. Research conducted by Gershuni and his associates during World War II established that patients suffering from closed craniocerebral trauma manifested a cutaneogalvanic response to audio stimuli that were 30-40 dB below the audibility threshold. The size of the subsensory zone of one and the same patient has since been shown to fluctuate from 0 to 50 dB from day to day depending on that patient's clinical condition: The subsensory zone becomes bigger as a patient's emotional state deteriorates. Gershuni's work on subsensory reactions has been used by others, including I.S. Beritashvili, to explain the

nervous mechanisms of blind people's spatial orientation. Beritashvili's work provided additional confirmation of Gershuni's notion that during pathological states of the central nervous system, the number of external stimuli that are not consciously perceived by a person but that induce various autonomic, bioelectric, and motor reactions increase significantly. Another important contribution of Gershuni and his associates was the idea (which he confirmed through laboratory studies) that the simultaneous effect of a set of stimulants on the sense organs creates conditions favorable to the formation of subsensory conditioned reactions. Gershuni's work in the area of the physiological mechanisms of unconscious psychic phenomena in man was abruptly halted in the early 1950s by what has since been termed the "Pavlov" joint session of the two academies. His work was only rebegun and continued 20 years later, but by different teams of researchers. One continuation of Gershuni's work has been in the form of studies of the effect of photostimulation on the audio stimulus detection threshold of healthy persons, patients suffering from the consequences of craniocerebral trauma, and individuals with emotionally labile personalities. Other areas that Gershuni's work has been taken up are that of the link between focused attention and the fixing of information in the long-term memory and the effect of unconsciously perceived words associated with negative emotional experiences. Perhaps Gershuni's most important hypothesis was that the levels of organization of nervous activity required for conditioned reflex responses and perceptions are not identical (albeit close to one another) and that perception requires a higher degree of organization of nervous processes than simple conditioned reflexes do. References 25: 24 Russian, 1 Western.

### PHARMACOLOGY AND PHYSIOLOGY

#### Antioxidant-Induced Improvement in Monkeys' Cognitive Characteristics: Neurophysiological Correlates in the Visual Cortex

947C0103B Moscow *FIZIOLOGICHESKIY*  
*ZHURNAL SSSR IMENI I.M. SECHENOVA*  
in Russian Vol 78 No 12, Dec 92 (manuscript received  
10 Apr 92) pp 78-87

[Article by K.N. Dudkin, V.K. Kruchinin, and I.V. Chuyeva, Brain Neuron Function Regulation Laboratory (laboratory head, M.O. Samoylov), Physiology Institute imeni I.P. Pavlov, Russian Academy of Sciences, Saint Petersburg; UDC 612.825.54+612.822.1]

[Abstract] A study examined the effect of the antioxidant oxymetacyl (6-methyl-5-oxyuracyl) in doses of 4-5 mg/kg (injected intramuscularly) on the cognitive characteristics of three rhesus monkeys that had been taught to perform the task of delayed visual differentiation of



stimuli of different colors. Bundles of microelectrodes were used to simultaneously register the activity of several single neurons (up to four) of the monkeys' visual cortex. The pulse activity of each neuron was registered over several hours. At each stage of the visual recognition process, the average frequency of neuronal activity and other statistical characteristics were calculated, and graphs of auto- and cross-correlation functions of neuronal activity were plotted. The number of correct decisions made by the monkeys and their motor response times were recorded. During the course of the study, 212 visual cortex neurons were registered. The motor response times and skill of the three monkeys in differentiating the colors of test rectangles varied greatly. The response time of monkey 1 was 1.5 to 2 times faster than those of monkeys 2 and 3, and before the oxymetacyl injections, monkeys 1 and 2 were could not correctly differentiate colors with a frequency greater than that of random guessing after delays of 4 seconds, whereas the ability of monkey 3 to successfully differentiate colors did not deteriorate to the frequency of random guessing until the delay was increased to 32 seconds. Despite these significant differences between the individual monkeys' skill levels before receiving injections of oxymetacyl, they all manifested identical behavioral and neurophysiological responses to the antioxidant. With rare exceptions, the likelihood of all of the monkeys making a correct color decision increased at all the delay times tested. In the case of monkeys 1 and 2, their duration of short-term memory of information after the oxymetacyl injections increased by a factor of 2 to 4. The time required for a correct motor response after the oxymetacyl injections also increased significantly in the case of all three monkeys. A corresponding significant decrease in time required for the monkey to make an incorrect decision was also noted. All of these changes in behavioral characteristics after the injection of oxymetacyl were accompanied by significant rearrangements of the pulse activity of the neurons of the visual cortex of all three monkeys in all four stages of the color recognition process. The study results were interpreted as an indication that oxymetacyl possesses nootropic properties. The observed behavioral changes following the injection of oxymetacyl were attributed to oxymetacyl's ability to increase the efficiency of control processes such as selective attention and motivation. Figures 6; references 17: 12 Russian, 5 Western.

**Contractile Activity of Lymphatic Microvessels and the Role of Opioid Peptides in Its Microregulation**

947C0103C Moscow FIZIOLOGICHESKIY  
ZHURNAL SSSR IMENI I.M. SECHENOVA  
in Russian Vol 78 No 12, Dec 92 (manuscript received  
23 Oct 91) pp 109-118

[Article by V.K. Khugayeva, General Pathology of Microcirculation Laboratory (laboratory head, P.N. Aleksandrov), General Pathology and Pathological Physiology Scientific Research Institute, Russian Academy of Medical Sciences, Moscow; UDC 612.42:577.151.17]

[Abstract] The phase contractile activity of the lymphatic microvessels of the mesentery of the rat small intestine was studied. The studies were performed in the morning on 90 unfed nonpedigree male rats that weighed 210-320 g each and that had been anesthetized with nembutal (0.1 g/kg injected intramuscularly). A photometry-based method was used to record the phase contractile activity of the wall and the motor activity of the valves of lymphatic microvessels located in three segments of the mesentery: the "transparent" section, the section around the adipose tissue at the periphery of the mesentery, and in the adipose tissue itself. The microvessels studied ranged from 30 to 300  $\mu$ m in diameter. During the course of the studies, leu-enkephalin, naloxone hydrochloride, dalargin, and adrenalin hydrochloride were applied to the surface of the lymphatic microvessels in doses of 0.004 to 40.0  $\mu$ g per kilogram of the animal's weight in 0.1 ml of a 0.14 M sodium chloride solution. Computer processing of the study data confirmed that the lymphatic microvessels of the rat mesentery do not contract rhythmically either spontaneously or under the effect of opioid peptides. Leu-enkephalin and dalargin (40  $\mu$ g/kg) increased contractile activity to different degrees. Leu-enkephalin mainly affected the valves: It activated the frequency and doubled the amount of time for which the cusps were closed. It had a lesser effect on the microvessels' walls but did increase the duration of each contraction. Dalargin, on the other hand, did not affect the valves even 30 minutes after application but did activate the walls of the lymphatic vessels. The combination of the opiate receptor antagonist naloxone or adrenalin with leu-enkephalin, both soon (15-20 minutes) and long (1.5-2 hours) after application, caused the walls of the lymphatic microvessels to be hypersensitive to nonspecific stimuli (a physiological solution of sodium chloride or air stream). Adrenalin and naloxone modulated the lymph-stimulating effect of leu-enkephalin and dalargin by inhibiting the lymphatic microvessels' contractile activity. Figures 5, table 1; references 20: 17 Russian, 3 Western.

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